DOCUMENT RESUME

ED 349 617 CS 507 964

TITLE	Proceedings of the Annual Meeting of the Association for Education in Journalism and Mass Communication (75th, Montreal, Quebec, Canada, August 5-8, 1992). Part X: Health, Science, and the Environment.
INSTITUTION	Association for Education in Journalism and Mass Communication.
PUB DATE	Aug 92
NOTE	217p.; For other sections of these proceedings, see CS 507 955-970. For 1991 Proceedings, see ED 340 045. Some papers may contain light type.
PUB TYPE	Collected Works - Conference Proceedings (021) -- Historical Materials (060)
EDRS PRICE	MF01/PC09 Plus Postage.
DESCRIPTORS	Acquired Immune Deficiency Syndrome; *Audience Response; Cognitive Processes; Communication Research; Foreign Countries; Media Research; *News Reporting; Programing (Broadcast); Risk; Science History; Sexuality; Space Exploration; Television
IDENTIFIERS	*Environmental Reporting; Health Communication; Print Media; Rhetorical Strategies; Science News; *Science Writing

ABSTRACT

The Health, Science, and the Environment section of these proceedings contains the following seven papers: "Columbus, Mars, and the Changing Images and Ideologies of Exploration: A Critical Examination" (Lin Bin and August T. Horvath); "Prime Time TV Portrayals of Sex, 'Safe Sex' and AIDS: A Longitudinal Analysis" (Dennis T. Lowry and Jon A. Shidler); "Reading Risk: Public Response to Print Media Accounts of Technological Risk" (Susanna Hornig and others); "Strategies of Evasion in Early 17th Century French Scientific Communication" (Jane Thornton Tolbert); "Words and Pictures: Expert and Lay Rationality in Television News" (Lee Wilkins); "News from the Rain Forest: The Social Integration of Environmental Journalism" (Allen Palmer); and "The Science Newswriting Process: A Study of Science Writers' Cognitive Processing of Information" (Jocelyn Steinke). (SR)

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ED349617

PROCEEDINGS OF THE ANNUAL MEETING OF
THE ASSOCIATION FOR EDUCATION IN JOURNALISM AND MASS COMMUNICATION

(75th, Montreal, Quebec, Canada, August 5-8, 1992).

Part X: Health, Science, and the Environment.

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Columbus, Mars, and the Changing Images and Ideologies of Exploration: A Critical Examination

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July, 1992

Running head: Images and Ideologies

Submitted to the Qualitative Studies Division of 1992 annual meeting of the Association for Education in Journalism and Mass Communication, Montreal, Canada.

Abstract

The present paper critically examines the changing images of the Columbus Maritime Voyages and the Mission to Mars. The paper views these changes as the results of the changing ideology of technology and scientific exploration developed during the past few decades. Drawing from theories of imagery, representation, and symbolic interaction, the paper argues that changing ideology has altered the representational environment in which it is no longer possible to construct human exploratory voyages as terminal activities, rather than as instruments of commercial and nationalistic expansionism and the influence of powerful interests. The value of these ventures must be reassessed when new motivations and consequences become part of their public images.

Columbus, Mars, and the Changing Images and Ideologies of Exploration: A Critical Examination

Human space exploration in the 20th century has often been compared with the 15th and 16th-century maritime voyages of the Europeans to America and Asia (e.g. Boorstin, 1973, pp. 599-600; Collins, 1990, pp. 153-155; Oberg, 1982, p. 65). The National Aeronautics and Space Administration seeks to establish a continuity between the seafarers of antiquity and modern interplanetary robot probes named "Mariner," "Viking," and "Voyager." The prospect of landing people on Mars--the first truly new world within the potential grasp of spacefaring technology--especially calls forth comparisons with the voyages of Christopher Columbus (e.g. Collins, 1990).

The 500th anniversary of the first Columbus voyage has occasioned a reexamination of popular imagery surrounding the Columbian expeditions and the subsequent activities of Europeans in the Americas. In particular, the notion that Renaissance voyages to the Americas were a terminally valued activity--representing the challenge of exploration or of technological enterprise for its own sake--is threatened by the realization that early intercontinental exploration was primarily instrumental to economic and political interests. In evaluating these adventures, the interests increasingly seen to have motivated the early ocean crossings are now weighed with respect to the overall welfare of both the discovering and "discovered" societies.

The present paper argues that a similar transformation may be taking place in current discussions of a human expedition to the planet Mars. In contrast to the orbital and lunar voyages of the 1960s, current human space exploration cannot justify itself on the basis of a drive for purely scientific discovery or an exhilarating technological challenge. Viewing changing ideology as the decisive factor in the transformation of public representations, the present analysis connects changing images of technology and of exploration to divergent interpretations of the exploratory voyages of both the Columbian and current eras.

Images

The comparison of space exploration to the sea voyages of the Renaissance, especially by proponents of the modern enterprise, is an appeal to popular images, or representations, of what is often called the Age of Discovery. Images, as conceptualized by Boulding (1961), are roughly the sum and organization of what persons believe--their "subjective knowledge"--about some referent. These subjective knowledge structures are built from experience, both direct and communicated by others.

Incoming messages about objects alter existing structures of knowledge about the objects, depending on their interaction with the individual's preexisting value systems.

The image construct is generally similar to the social representations examined more recently by sociologists such as Moscovici (1984). Moscovici emphasizes the importance of communication in the construction of representations, which he defines as the set of an individual's beliefs about an object. Moscovici stresses the role of representations in perception, noting that people perceive and react to the representation, not the "objective" form, of an object. Representations provide categories for objects, allowing newly experienced items to be comprehended and incorporated within existing notions of how the world is organized.

Boorstin (1961) offers yet another conception of image, defined somewhat more strictly than either Boulding's images or Moscovici's representations. For Boorstin, images are depictions of objects or events that are intentionally constructed for mass propagation. Boorstin connects the purposeful mass-construction of images largely with recent times and with the opportunities afforded by mass media technologies. Unlike Boulding and Moscovici, Boorstin assumes that there can be a perception of the true world undistorted by imagery--if we undertake to "disillusion ourselves" (Boorstin, 1961, p. 6).

Almost all current perspectives on imagery and representation owe a substantial but often unacknowledged debt to a handful of American scholars whose theories were later termed "symbolic interactionism." The most important of these scholars from the standpoint of the social psychology of perception, George Herbert Mead, advanced a theory of social interaction based on constructed representations of the self and of the "generalized other," or the community as it is imagined to interact with the self-representation (1956, p. 218). Although Mead included inanimate objects among the elements of the generalized other, he was primarily interested in social interaction and thus focused on other people as referents for this form of representation. John Dewey (1958), a philosopher associated with the symbolic interactionists, constructed a more elaborate analysis of "meanings," or perceptions of experience conditioned by prior knowledge. Symbolic interactionism has matured into a school of social psychology (Cardwell, 1971) and has inspired traditions such as "social construction" theories of scientific and other knowledge (Berger & Luckman, 1966).

A definition of "image" akin to those of Boulding and Moscovici is adopted for the present purpose of analyzing images of Columbus and of flight to Mars. Recognizing, with Boorstin, that an image is a definition or interpretation and that communication plays the critical role in its development, the present analysis assumes, with Moscovici and the symbolic interactionists, that the world can be experienced only through social images or representations rather than directly. Granting that academic history is a type of representational experience, the present paper will stress changing imagery and will make only tentative appeals to historical evidence.

The point of departure, however, for the present paper is to explicate the relationship between image and ideology. "Ideology" has been used in several different senses by critical communication researchers (Williams, 1977). The present authors use the term as employed by Hall (1989, p. 307), to mean "patterns of ideas, belief systems, or interpretive schemes found in a society or among specific social groups." Rather than treating ideologies as false systems of meaning and opposing them to truer more accurate interpretations of social reality, the content of certain influential ideologies with respect to particular referents is here examined, and aspects of the process by which ideologies are shaped within social groups are described.

As we have argued in our previous studies (Horvath & Lin, 1991), images play a key role in the propagation of ideologies to large populations. The ideologies of social groups are expressed, negotiated, and communicated largely through the exchange of images. Images include the evaluative beliefs we have about such things as polity, economy, technology, and exploration. These evaluative beliefs form important components of ideological bases. Similar to the functions of museums and theme parks (Horvath & Lin, 1991), images of human exploratory activities can be depicted in ways that glorify a nation's origin and justify rationalist, individualist, and often expansionist cultural values. Such ideologies determine the ways in which the society's images of history evolve and are communicated to subsequent generations (Horvath & Lin, 1991). Images, while not always direct statements of cultural values, serve nonetheless as value leakages of a nation's ideological tendencies. By studying images and their change, we can understand the evolution of a nation's ideological predispositions.

Images of Columbus

Until recently, the association of the Columbus image with space travel could be trusted to carry only the most favorable connotations, especially in the United States. Columbus has been among the unblemished heroes of American cultural mythology (Boorstin, 1965, p. 366). His stature is reflected in the ubiquity of his name, which adorns the U.S. capital district, several cities, a premier university, a Space Shuttle, the Chicago Exhibition of 1893, a national holiday, and innumerable statues and monuments. Zelinsky (1988, p. 29), in his review of symbolic expressions of U.S. nationalism, stresses the importance of these honors in view of the United States' general reluctance to acknowledge early explorers as cultural heroes. Boorstin (1983, pp. 175, 244), like Zelinsky, observes that no other explorer is significantly represented in U.S. monuments and place-names, although numerous candidates are available. Columbus is ironically accorded the position of "ultimate founding father" (Zelinsky, 1988, p. 29) although he never set eyes upon what was to become United States territory.

Such favorable images of Columbus, argued Zelinsky (1988), helped to promote America's nationalistic spirit and to glorify its ancestry. By emphasizing the terminal value of Columbus' seafaring over its instrumental value, the popular images of Columbus' cross-continental exploration highlight the quest for technological and scientific challenge itself and understate the political and economic interests motivating the voyages. Such an ideological construction of Columbus' images leads the public to associate early American history with its strong desire for technological enterprise, and thus to neglect its equally strong penchant for exploitation of natural resources and native peoples.

The voyages of Columbus have been amply documented (and, necessarily, represented as images) by historians, assisted by the concern for posterity of Columbus himself. With respect to Columbus' motivations for his voyages, the consensual interpretations offered by historians are, briefly, that Columbus sought (1) wealth and power through being the first European merchant seaman to trade directly with Asia, without Middle Eastern intermediaries; (2) his own divine destiny of locating the quasi-mystical Asian lands; and (3) the presentation of new peoples to God as represented by the Roman Catholic Church (Morison, 1978, pp. 366-371). The relative importance of these goals to Columbus is a matter for conjecture.

From historical accounts, it appears that the first and third of Columbus' motivations--especially the first--were decisive, from the Spanish monarchy's standpoint, as arguments for funding Columbus' initial voyage. The first Columbian expedition, as seen from the Spanish throne, was a moderately expensive economic gamble whose slim chances of success very nearly offset the massive potential payoff (Morison, 1978, pp. 371-384). Perhaps only the personal rapport between Columbus and Queen Isabella or the ominous success of the Portuguese in rounding Africa (Boorstin, 1983, p.228) tipped the scales in favor of the voyage.

While the economics of Asian trade and the politics of Spanish-Portuguese competition seem to have been important factors in the Columbian voyages, from the standpoints of Columbus' sponsors and possibly for the explorer himself, it is the quest for discovery itself that has received by far the most attention in popular imagery. The European tradition of seafaring discovery is associated, not primarily with a strong drive for economic and political expansion, but with the Renaissance values of the search for knowledge and rational understanding. According to Boorstin (1983, pp. 178-201), the locus of 15th and 16th-century discovery in Christian Europe, rather than in Arab territories or China, can be explained by the cultural complacency of the Eastern empires. Despite their often superior navigational technology and competence, these civilizations are defined by Boorstin as inward-looking rather than outward-reaching due to their lack of the Renaissance thirst for curiosity and exploratory challenge. While Boorstin (1983, p. 180) concedes that this image of Eastern civilizations plays to European stereotypes, he does not recognize that such stereotypes may have led Westerners to develop and accept the popular imagery of explorers such as Columbus and of their idealized Renaissance-inspired philosophical motivations.

As far as historians can determine, however, and unusually vividly in the case of Columbus' own life, the type of exploratory feats celebrated by current images of the Renaissance tradition were not always rewarded at the time they were accomplished. Columbus' prestige declined rapidly with his later voyages as the realization dawned on the Spanish that the lands he had reached were a new but unprofitable continent (Morison, 1978). Columbus himself retained to his death the belief that he had found Asia, the alternative being to admit dismal failure. This strong preference for reaching a known and wealthy land rather than an entirely new, but commercially undeveloped one contradicts the popular assumption that explorers were ideologically guided by the discovery of new territories for their own sake. In assigning these attitudes to Columbus and his contemporaries, we project current thinking and idealized Renaissance philosophy onto our images of the events.

Modern representations of events such as the journeys of Columbus are invariably subject to the inadequacies of surviving evidence and the ideological interpretations imposed by intervening and current cultural experience. The requirements of cultural mythology in the United States (e.g., an appropriately noble tale of the nation's origin; early heroic personages; and ideological justification of rationalist, individualist, and often expansionist cultural values) determine the ways in which the society's images of history evolve and are communicated to subsequent generations. But these ideological requirements are not static. In the latter decades of the 20th century, and most dramatically during the 1960s, shifting elements of economics, culture, and politics have altered the American perspective on exploration. The exploration of space serves as the most visible site for this change.

Missions to Mars

Long a subject of science fiction, human expeditions to Mars were considered seriously in the United States at the time of the Apollo moon project in the 1960s. During this period, the National Aeronautics and Space Administration (NASA) prepared a proposal calling for astronauts to land on Mars by 1982 (David, 1985, pp. 36-37). Even as the Apollo 11 crew sped toward the first lunar landing, U.S. Vice President Agnew articulated the goal of an expedition to Mars by the year 2000 (David, 1984, p. 5). The pledge of Mars-by-2000 has been repeated at various times (Schmitt, 1985), most recently (albeit least realistically) by President Bush in 1988 (Collins, 1990, p. 179).

By the late 1960s, however, the United States' economic and political landscape was not what it had been in 1961 when President Kennedy launched Apollo, and images of human space exploration were shortly also to undergo a transformation. In 1961, the United States had recently received the political-technological shock of seeing the

Soviet Union orbit the first satellite in 1957 (Schmitt, 1985) and the first human earlier that year (Collins, 1990). With no wars then draining the U.S. economy (Byerly, 1989, p. 20), the nation was prepared to embark on an unprecedented outlay, not only for military and space research and development, but for scientific, mathematical, and technical education, whose architectural legacy remains obvious on university campuses after 30 years.

A contemporary elementary school science text (Schneider & Schneider, 1959) neatly captures the ideological imagery associated with discovery at the start of the space race. Under the question, "What makes people explore?" the first reason provided is curiosity: "they want to know as much as they possibly can about the world in which they live." Second is "that people want a good life for themselves and others." Finally, "they want to search for things of value" (Schneider & Schneider, 1959, p. 3).

This image of exploration as primarily a search for knowledge for curiosity's sake was sufficient to ensure that Apollo received the necessary support from the American government and public (Collins, 1990). The principal payoff was not in scientific knowledge; Byerly argues:

> "Apollo was not primarily a scientific program but clearly one of exploration, i.e. the science involved was important but not essential to the decision. . . .

> The decision to go to the Moon presented a final goal--it was an end in itself." (Byerly, 1989, p. 20)

Issues such as scientific usefulness and technological spinoffs, while they were deployed to bolster the Apollo program and also to attack it, were secondary to the overriding technological challenge, exploratory exhilaration, and nationalist achievement in the pubic construction of Apollo.

Other factors contributing to the Apollo decision at high levels failed to secure a place in popular imagery, being inconsistent with the ideological requirements of space advocates and the U.S. public; the military impetus to develop and test new ballistics technology and the economic interests of the aerospace industry might be offered as examples. As one of the Apollo astronauts reports from his experience, even the well-publicized international-competitive aspect of the lunar landings paled next to terminal value of the impressive achievement itself for all of humanity, in America and abroad (Collins, 1990, p. 151). This image of space exploration maintained the required popular support of Apollo through the first landing or two. Predictably, once the technological accomplishment had been achieved, public interest in the subsequent lunar landings declined quickly (Collins, 1990, p. 152). The first landings had served the program's ideological purpose; the later missions, although more scientifically productive, were of less interest to popular imagery.

Political, and especially Presidential, interest in further interplanetary excursions also waned rapidly after Agnew's 1969 announcement (David, 1985). Geopolitical and economic circumstances had changed. The space race appeared to be over, or at least the racers had started running in different directions. The United States had initiated a costly military venture in Vietnam. But the 1960s were also a time of cultural and ideological change in the United States. By the end of the decade, while the nation could still take time to celebrate the consummation of the exploratory enterprise begun earlier, important countercurrents to the drive for exploration and expansion were swirling around space program decisions.

Gouldner (1976, p. 7) argues that modern ideology has been shaped by the growing prestige of modern science and technology. Gouldner attributes the development of the public's favorable judgment of modern science to the declining authority of religious and philosophical discourse. The present analysis extends Gouldner's argument by demonstrating that the public's favorable attitude toward technology has undergone further changes during the past decades. From viewing science and technology favorably as terminal activities, the public came increasingly to perceive the role of science and technology as subordinate to social goals. National and human "progress" came to be defined less as scientific and technological achievement, and more as economic and political achievement with the assistance of science and technology.

Among the most notable ideological shifts in 1960s America was a growing disaffection with large scale technological enterprise for its own sake. The intellectual content for the shift was furnished by a number of prominent social philosophers. Lewis Mumford had first explored his thesis that large-scale, centrally coordinated technological projects are symptomatic of totalitarian, dehumanizing societies before World War II (Mumford, 1934), but found renewed popularity (and, with the space program, a wealth of new examples) in the late 1960s (Mumford, 1967, 1970). Marcuse's (1964) influential Marxist analysis of twentieth-century technology held that capitalists had successfully harnessed the intrinsically liberating promise of technology as a tool for extending their hegemony over the working classes. Ellul (1964) protested the triumph of technical efficiency as the arbiter of achievement in modern society, at the expense of aesthetic and human development. This new ideology of technology and exploration was further articulated within the new "alternative technology" tradition in technology studies (Dickson, 1977) and through more popular writers such as Theodore Roszak (1972). In general, the prevailing ideology and imagery of technology increasingly presented technical projects as economic and political endeavors which could and should be controlled, rather than being allowed to develop unquestioned.

Such changes in ideology of technology and scientific exploration caused a shift in public images of technological enterprise from inherently desirable activity to one that probably serves certain powerful interests, and that should be balanced against the interests of broader segments of society. Technological and scientific enterprises became increasingly hard to justify for their own sake; accordingly, human exploratory activities called for reassessment. As Basalla (1988, p. 156) notes, this new public scrutiny of technological proposals caused the termination of the U.S. supersonic transport (SST) during the 1968-71 period.

> "The SST symbolized big government acting in behalf of big business and unbridled technology without regard for the rights and well-being of ordinary citizens. . . . Never in modern times had there been such a clear and concrete public challenge to the belief that technological change was progressive and inevitable." (Basalla, 1988, p. 157)

Very likely, a serious effort for a human journey to

Mars around 1969 would have come up against the same change in public imagery of technology that killed the SST. Unlike NASA, however, the U.S. Congress immediately sensed the change and established new ideological bases for space exploration. The space enterprise was no longer described as a terminal goal; it needed to be instrumental, to generate (at least apparent) material benefits for the nation and society as a whole. Space projects consistent with the new images of technology were needed, and were quickly proposed in the forms of the Space Shuttle and, later, a permanent space station.

> "The Apollo decision was, both intrinsically and as presented to the public and to Congress, fundamentally different from the Shuttle and Station decisions. . . . Both the Shuttle and the Station are actually means to an end rather than ends in themselves." (Byerly, 1989, p. 20)

If the Apollo missions were comparable to early European ventures to new territories, the Space Shuttle could be likened to the development of an efficient cargo vessel to ply proven routes--although the expected savings in launch costs per payload pound proved unrealistic (Easterbrook, 1989).

The new ideology of technology in general, and of space exploration in particular, defines the representational environment in which current discussion of Martian voyages is conducted. Where the Apollo program's supporters emphasized challenge and difficulty, Mars proponents must stress feasibility and economic benefits (e.g. Boston, 1984; McKay, 1985; Reiber, 1988; Stoker, 1989a, 1989b). Recent Mars initiatives have mentioned such long-term projects in the Mars neighborhood as mining asteroids (Chen, 1991).

Perceptual changes also act retrospectively to redefine past experience. Early attempts to redefine the Apollo project as a political and economic venture occurred while Apollo was still underway (e.g. Etizioni, 1964). In the light of changing imagery and ideology relating to technology and exploration, the moon landings may come to be perceived less favorably by the younger generation who did not experience the exhilarating television broadcasts of the Apollo program and therefore are unable to recall the idealized memory of the event. Indeed, as the 500th anniversary of Columbus' first journey approaches, the question may increasingly be asked: Has any major journey of discovery truly been motivated by the Renaissance values of curiosity and the self-justifying drive for exploration?

Recent Changes in Images of Exploration

The revision in public imagery prompted by the technological disillusionment of the 1960s and the pre-1992 reevaluation of Columbus moves toward the premise that human exploration is, and has always been, primarily an economic and political enterprise, rather than an idealistic pursuit of curiosity-satisfaction. Prominent among the political and economic interests served by the exploration of new worlds in the 20th century is institutionalized technology. Institutionalist economists (Veblen, 1918; Galbraith, 1967) have argued that the importance of technology providers as agents of economic and political power is a unique feature of the modern, industrialized world. Indeed, there is no historical indication that 15th-century Spanish and Portuguese shipbuilders lobbied for higher public exploration budgets to finance their own technological priorities. But some political and economic forces currently depicted as driving space exploration, other than those of the technological industries, can be envisioned as surprisingly consistent over the centuries.

Economic Exploitation of New Worlds. Although images of the Columbian voyages have always included the Spanish commercial interests that enabled the journeys--in part because they contribute to a good narrative--these have generally been relegated to the subordinate role of illustrating the tribulations Columbus had to endure to pursue his great dream of discovering new territories (or, in a myth long perpetuated in schoolbooks [e.g. Schneider & Schneider, 1959, p. 4] of proving the Earth to be spherical). More recently, beginning with academic interpretation (Morison, 1978) and seeping into public imagery, the image of Columbus as primarily motivated by commercial concerns has begun to displace the older interpretation.

Traditional imagery of the Columbian voyage suggests that, after the original disappointment at not finding a new route to the spice trade, exploratory motivations for journeying to the Americas replaced commercial ones. Current efforts to redefine the imagery of Columbus' expeditions remind us that the Spanish, upon initially finding no advanced trading civilization in the New World, were quick to shift their economic intentions from trade to outright looting. This practice followed and greatly reinforced a long-standing exploitative tradition in Africa and, through its interaction with the slavery institution, resulted in the quick eradication of most of the societies with which initial contact had been made (Morison, 1984). Later, of course, similar economic drives were to destroy ancient populations on a continental scale. It is only recently that a newly sensitive American imagery has associated the destruction of the native peoples closely with the original intentions of Columbus and other explorers, rather than assigning the blame (if blame was assigned at all) to the zeal of subsequent colonists and adventurers.

In contrast to the exploratory and quasi-scientific focus of pre-Shuttle orbital and lunar space flight, future expeditions to the Moon and planets are represented both by proponents and the public as largely oriented around the search for economically exploitable resources. The more enthusiastic spokespeople for space colonization advocate, essentially, the strip-mining of the Moon to provide materials for the venture (Brand, 1977). Mars, its moons, and the asteroid belt have also been identified as sources of mineral and other resources (Chen, 1991; Rotegard, 1989). The awareness of economic exploitation, while it represents a new image both of ancient maritime and modern space exploration, constitutes an argument against flight to Mars only if value is placed on protecting the natural condition of celestial bodies or of whatever life may be found there. After some initial controversy about how carefully interplanetary probes should be sterilized (Bradbury, Clarke, Murray, Sagan & Sullivan, 1977, pp. 23-24, 29-31), discussion of the value of protecting Martian life has receded in the face of inconclusive but generally negative life-test results from the Viking robot probes. Serious practical questions of whether the inanimate features of celestial bodies should be despoiled as little as possible may yet arise, and if they do, they will indicate yet another striking ideological transformation, compared to the relatively recent insensitivity to the eradication of whole human civilizations.

Colonization, Imperialism, and National Prestige. The flags of the United States of America presently "fly" over the surface of the Moon. The planting of these flags, even though they no longer signify a territorial claim by the voyaging country, maintains a direct symbolic and ideological continuity with the first acts of European explorers on reaching their new worlds and claiming these for their sponsors. The behavior of Earthly nations toward the last terrestrial "new world"--the Antarctic continent--demonstrates that colonial impetuses continue to prevail and enlightens the interlocking reasons for territorial expansion.

Traditional imagery, notwithstanding Columbus' pre-expeditory demand to be made governor of the territories he discovered, has indicated that 16th-century colonialism was an afterthought, stemming from the unexpected discovery that most of the lands of the new world were not occupied by technologically advanced civil authorities. More recently, economic and political reasons for the colonization of the Americas and more critical evaluations of this colonization have been provided, largely by individuals and groups representing remnants of pre-existing American civilizations. Political communication from these long-silenced populations has been a key catalyst for the present restructuring of popular imagery and ideology of colonization and its effects.

The establishment of permanent colonies in the Americas in the 16th century was, of course, intimately connected with economic exploitation, as are the projected colonies on the Moon and elsewhere (Brand, 1977). It is difficult to ascertain the extent to which a second element of colonialism--international competition for prestige--played a role in the voyages of Columbus and others, as opposed to the more manifest Spanish-Portuguese economic competition for Oriental trade routes (Boorstin, 1983, p. 250). With respect to the Apollo moon program, the initial space-race rationale that technological pre-eminence was necessary for military and economic security appears to have lost ground to a retrospective image of the lunar landings' competitive aspect as essentially a bid for national prestige--still defended as a legitimate basis for Martian travel (Collins, 1990, p. 174).

Perhaps the most explicit recognition of the nationalist-colonial aspect of voyages of discovery has been evident in the attention paid to the possibility of international (especially U.S.-Soviet, but often including other nations) expeditions to the Martian surface (e.g.

Foreman, 1989; Goldman, 1985, 1989). In contrast to the 15th century, when maritime trade routes and charts were among the most carefully preserved of state secrets (Boorstin, 1983, pp. 267-271), and the space-race era, when similar secrecy about technology rather than geography prevailed, the suggestions--even if controversial (Michaud, 1989)--of interplanetary cooperation between superpowers indicate a redefinition of the appropriateness of nationalism in images and ideology of exploratory enterprise.

Conclusion

Collins (1990, p. 152) suggests that Apollo "was not perceived as a gateway to the future but as an end in itself. A Mars mission, if constructed along Apollo lines, will also be so considered." But Collins begs the question of whether it is any longer possible to ideologically construct (or "represent") human exploratory voyages as terminal activities, rather than as instruments of social interests and, one hopes, of human welfare. It may be impossible to propose a project such as Apollo in the face of changed images and ideologies of technology and the purposes of exploration; surely it would be impossible to propose the project with the same rationale.

More realistically, Murray (in Bradbury et al., 1973, p. 67) has observed, "the rapid Apollo build-up has been followed by a rather rapid dropoff, due to the volatile nature of our political system as well as, perhaps, to a rapid and painful maturing of our people." Murray defined this maturing as the public's appreciation of "the full complexities and limitations of [the] ethic . . . that technology can solve all their problems." Concurring with Murray, the present analysis would add that a changing ideology of human exploratory activity, considering economic and political elements of the quest for new worlds, has altered the representational environment in which new efforts of discovery are contemplated and old ones assessed. Briefly, commercial and nationalistic expansionism and the influence of powerful interests are increasingly represented as factors in both historic and modern human exploration of new worlds. The value of these ventures must be reassessed when new motivations and consequences become part of their public images. The nature of the political struggle over flight to Mars is one manifestation of these shifts in ideology and imagery; the recasting of the Columbian voyages on their quincentennial is another. Perhaps more important, the new mode of representations of discovery may condition exploratory activity for many decades to come.

There is no reason to suppose that ever-changing images of discovery and of technology will suddenly become static. Nor is it plausible that the traditional representations of these activities will vanish. Social imagery evolves continuously through communication and changing ideology, and through interaction with present circumstances and with surviving relics of the past. So will the imagery of human space exploration.

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Prime Time TV Portrayals of Sex, "Safe Sex" and AIDS: A Longitudinal Analysis

by

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Presented at the annual convention of the Association for Education in Journalism and Mass Communication, Mass Communication and Society Division. Montreal, Quebec, Canada.

August 8, 1992

Prime Time TV Portrayals of Sex, "Safe Sex" and AIDS: A Longitudinal Analysis

A 1986 full-page newspaper advertorial published by the Planned Parenthood Federation of America accused the TV networks of "... putting out an unbalanced view [about sex] which is causing more problems for teenagers and society."[1] Lowry and Towles' content analysis of 1987 prime time network programs concluded: "... Planned Parenthood is correct in charging that the networks present a constant barrage of titillating sexual imagery and innuendo, but seldom portray the possible consequences of sexual behavior."[2]

Five years after Planned Parenthood made its public criticisms of the networks, the Secretary of Health and Human Services stated, "Today I call upon the media to turn down the volume on irresponsible sex .... Too many of our youth are being raised by a TV nanny that glorifies casual sex ...."[3]

Planned Parenthood and the Secretary of Health and Human Services are not alone in their concern over both the number and nature of sexual behaviors presented on TV. A 1990 national phone survey of 500 adults conducted by a major advertising agency found that 71% of the respondents believed that the amount of sexual content had increased between 1989 and 1990.[4] In 1991 The Gallup Organization interviewed 1,012 adults by phone and found: 58% of the respondents said they were occasionally or frequently offended by something in a TV program, 19% were specifically offended by sex or sexual suggestiveness, and 41% said that offensive programming had increased in the last year.[5]

The public concern about sexual portrayals on TV of course has not been occurring in a vacuum. It has been occurring during a growing epidemic involving almost 200,000 AIDS cases as of the end of October 1991, with an estimated one million additional Americans infected with the AIDS virus.[6] While most Americans are aware of the AIDS epidemic, most are not aware of the parallel epidemics of other sexually transmitted diseases (STDs), such as chlamydia (4 million cases per year), ghonorrhea (1.4 million cases per year), genital warts (1 million cases per year), as well as several other STDs.[7]

A Louis Harris survey of 1,000 teens indicated:

> Teenagers rank television as the fourth most important source of their information on both sex and birth control (out of 11 possible sources). Their reliance on television is of concern because the survey shows that many teenagers---not majorities, but very sizeable minorities---believe that TV gives a realistic picture of such topics as sexually transmitted diseases (45%), pregnancy and the consequences of sex (41%), family planning to prevent pregnancy (28%), and people making love (24%).[8]

It is not surprising that the television networks have been receiving an increasing amount of criticism for their portrayal of sex and for ignoring the possible consequences of sex. It is surprising, though, to find the the criticism coming from so many different sources.

Conservative organizations such as the American Family Association and CLeaR TV (Christian Leaders for Responsible Television) have criticized the networks for showing too much sex on TV, while the liberal organization People for the American Way criticized the networks for giving in to the conservatives.[9] Even the U.S. Senate "... unanimously adopted legislation aimed at restricting violent, sexually explicit and illicit drug-related material on television ...."[10]

Advertising personnel have also registered concern. A 1991 industry survey of 150 media buyers and advertisers found that "... 52% feel there was more sex and profanity in programming ..." in the 1990-91 season than in the past season, and "... 66% of respondents say they avoid buying shows considered too sexual or profane."[11] A former president of two major advertising agencies stated that ". . . sex and profanity could well be 'the principal reason' for the networks' [financial] woes."[12]

The primary weapon used by organizations opposed to the amount of sexual and violent content on TV has been sponsor boycotts, some of which indeed have been effective in pressuring sponsors. A 1991 phone survey of 1,060 adults indicated that 67% disagreed with the statement "Boycotts don't really accomplish anything," and 14% said they had participated in a product boycott within the last month.[13] One advertising agency executive stated: "We're all very sensitive to the pressure groups. We need to know just what kind of reality we're involved with. That's almost as important as the ratings the show gets."[14]

In 1989, "Chrysler Corp. and Sears, Roebuck & Co. pulled spots from NBC's 'Nightingales' series after the American Nurses' Association mounted a massive letter-writing campaign against advertisers."[15] Other companies which have pulled their commercials or which have asked their agencies to be more careful about commercial placements have been Mennen Co., Ralston Purina Co., General Mills, Coca-Cola Co. and McDonald's Corp.[16] Under pressure from CLeaR TV, Burger King published "An Open Letter To The American People" in 200 newspapers stating, "We pledge to support such programs [stressing traditional American values] with our advertising dollars."[17]

Based upon this review it can be concluded that (a) people from several important constituency groups believe that the amount of sexual content on TV has increased, (b) they are concerned or offended or angry about it, (c) some of them have organized sponsor boycotts, and (d) some boycotts work. However, several questions remain unanswered: Are the perceptions of increased numbers of sexual behaviors on prime time TV accurate? How much sex is portrayed on prime time TV? And is the trend up (as many believe) or down or constant?

This study had four main purposes, the first of which was to replicate the Lowry and Towles study of 1987 prime time programs and track changes in the numbers and types of sexual behaviors. Using the same category system as they did enabled us to make direct longitudinal comparisons on a category by category basis.

The second purpose was to include the sexual content of the program promos as part of the overall analysis of sex on prime time TV. While there have been a number of studies of sexual behavior on TV in the past two decades,[18] and there have been several studies of sex and violence in TV promos,[19] apparently no scholars have analyzed the sexual behaviors in both programs and promos within a single study. This limitation of past studies needed to be corrected. Even casual viewing of one evening of network TV would suggest that, if one wanted to measure the overall amount of sexual content on TV, then one would have to analyze both programs and promos.

The third purpose of this study was to measure what the networks were communicating to the American public about pregnancy prevention, AIDS and other STDs. Lowry and Towles' 1987 study found .20 behaviors per hour relating to pregnancy prevention, .27 per hour relating to STD prevention, and found that no one contracted any STD.[20] A content analysis carried out by Louis Harris and Associates for Planned Parenthood Federation reported ". . . less than 1/50 of one reference per hour of TV time to birth control or contraception . . ." and ". . . only 1/10 of one reference per hour to sexually transmitted diseases."[21] In view of the more that one million teenage pregnancies in this country each year,[22] and in view of the several epidemics of STDs discussed above, it is important to measure what the networks are communicating on these public health problems.

A fourth purpose, related to the third, was to determine to what extent the networks were suggesting that "safe sex" is the solution to the epidemics of STDs and AIDS. Noble, a medical professor, has argued for an entirely different message:

> Nobody these days lobbies for abstinence, virginity or single lifetime sexual partners. * * * I'm going to tell them [my daughters] that condoms give a false sense of security and that having sex is dangerous. * * * Unmarried people shouldn't be having sex. Few people

> have the courage to say this publicly. * * * There is no safe sex. Condoms aren't going to make a dent in the sexual epidemics that we are facing.[23]

Which message---the "safe sex" message, or the "there-is-no-safe-sex" message---was the primary message in the fall 1991 programs?

Method

The content universe for this study consisted of all of the ABC, CBS, NBC, and Fox prime time programs from Oct. 6 through Nov. 2, 1991. Prime time was defined as 7 to 10 p.m. (central time), Monday through Saturday, and 6 to 10 p.m. Sunday. All programs were included and coded in this study, including sports, news magazines, and reality-based programs such as "Rescue 911," and "COPS." They were included because (a) they were a part of the prime time offerings available to viewers, (b) some of them dealt with sexual topics, and (c) since promos were a part of this study, these programs did include promos for future shows.

A stratified random sample was used to select one constructed week (Sunday through Saturday) for each network. This total sample came to 88 hours of programming. Almost all of the categories were taken from the 1987 Lowry and Towles study,[24] so that we could make direct longitudinal comparisons.

Type of content had two categories: programs and promos for future prime time programs. All other promos---e.g., for afternoon programs---were excluded. All product commercials were likewise excluded.

Verbal suggestiveness was defined as references to sex that are one step removed from the type of direct references to intercourse described below. Included were sexual innuendos, double-entendres, organ humor (i.e., jokes about sex organs), and jokes about impotence. The following examples were included in this category: Woman to man: "Let me take your jacket . . . your pants." Woman: "I tried appealing to his mind, I tried appealing to his heart, and now I'm going straight to his thingie" [penis]. Woman to man: "We could play bellhop and the naked guest." The unit of analysis was the individual word or phrase.

Physical suggestiveness was defined as sexually suggestive *actions* or sexually suggestive *exposure of one's body*. In contrast to Erotic Touching (defined below), which involves one character touching another, physical suggestiveness applies only when one partner is *not touching another*. For physical suggestiveness, the camera shot was used as the unit of analysis. This means, for example, that if five strippers were on the screen simultaneously "bumping and grinding," this would count as one instance of physical suggestiveness. But if one stripper were shown on the screen in five different camera shots, this would count as five instances. The most common instances of physical suggestion were breast shots and derriere shots---referred to in the industry as "T and A shots."

Erotic touching was defined as interpersonal touching that had clear sexual overtones; demonstrating or intending to demonstrate sexual love; arousing or expressing sexual desire. Although not every behavior that has romantic overtones has sexual overtones, the category included "heavy" kissing, sexually romantic embraces and hugs, sexual caressing or touching of any part of someone else's body, and other similar touching behaviors. It excluded casual hand-holding, an arm casually around someone's waist or shoulder, a casual "peck" type of kiss, nonsexual greeting and farewell kisses, parent-child kissing and hugging (as long as incest was not implied), and other nonsexual touching. Brief "peck" types of kisses were counted, however, when they were part of an intercourse or implied intercourse scene. When the context was ambiguous, coders used a three second rule---i.e., kisses three seconds or longer were coded as erotic and shorter kisses were not coded. An erotic kiss that also involved an embrace counted as two instances of erotic touching if both acts met the above requirements. The unit of analysis was the behavior itself, not the number of individuals involved.

Heterosexual intercourse was classified as verbal, implied, or physically depicted. Verbal referred to spoken references to the act of heterosexual intercourse. Some examples were: "Does she sleep around?" "Let's make it tonight." "Did you dip your spoon [penis] into the pudding [her vagina]?" "We often sleep together." "I faked every orgasm." Implied was coded when the cameras depicted the start or end of lovemaking, but did not show the physical act itself. The most common example of implied intercourse on TV occurred when two lovers were in bed kissing and embracing, and then the cameras cut to a commercial break or a different scene. Another common situation was when the scene opened on the two lovers in bed "the morning after" a night of implied love-making. Implied intercourse scenes of this type were coded each time the scene appeared. For example, a single act of implied intercourse interrupted by a commercial break was counted twice. Thus, visual behaviors of this type were coded at the level of the scene, while verbal behaviors used sexual words or phrases within sentences as the units of analysis. Physical was reserved for actual physical portrays of intercourse, even though the actors might not be shown totally nude. The criterion was not the amount of skin that was showing but rather what the actors were portrayed as doing. Heterosexual intercourse was also classified according to whether the partners were married, unmarried, or of unclear marital status. The inclusion of promos in this study created some difficulty in classifying marital status. We coded them on the basis of what was revealed in the context of the promo itself. Therefore, a couple in bed might be coded as "unclear marital status" in one promo, while a different promo for the same program might later reveal that they were unmarried, and was coded accordingly.

The remaining categories were prostitution, aggressive sexual contact (including rape), homosexuality, incest, exhibitionism, masturbation, transvestism and transsexualism, voyeurism, other unnatural sexual behavior, pregnancy prevention, and disease prevention. Each of these categories was subdivided into verbal, implied and physical. The units of analysis for these categories were the same as those used above. The two final categories were HIV/AIDS contracted and other STDs contracted. These two categories were subdivided into verbal, implied, and infected person on screen. Sexually-related words or signs appearing on the screen were coded as verbal references, since words and not physical acts were shown.

Coding was done independently by the authors. A random sample of one half of the programs was coded by both coders to determine intercoder reliability. Agreement was checked on the smallest practical unit(s) of analysis (not based on totals at the end of a program) to make the reliability testing as rigorous as possible. Often this was a single word or a single kiss. Extended love-making scenes were usually subdivided into meaningful units such (e.g., ten or twenty seconds long) for coding and agreement checking. Using these methods, then, the overall proportion of intercoder agreement was .86. The proportion of agreement on the most-used categories was: verbal and physical suggestiveness, .79; erotic touching, .87; and heterosexual intercourse, .85. In cases where we disagreed in our frequency scores for a given behavior or scene, the mean of the two scores was used for data analysis purposes.

An important methodological point is that the coding system used this study, as well as in the Lowry and Towles 1987 study, was generally more conservative than used by Silverman, Sprafkin and Rubinstein[25] and by Louis Harris and Associates.[26] In their studies, if a man and woman kissed one time it was counted twice---once for the man and once for the woman---whereas in this study it was counted as one act of kissing. Likewise, in their study an implied intercourse scene was counted twice---once for the man and once for the woman---whereas in this study it was counted as one act of implied intercourse. In one type of situation, however, this study used a more liberal approach to tabulating behavior than did their studies. They counted implied intercourse scenes interrupted by a commercial break or by other scenes only once, while this study coded the implied behavior each time the scene appeared. Nevertheless, the coding system used in this study was generally more conservative than used in most previous studies.[27]

Results

Programs. The total number of codable behaviors in programs was 786.5, or 8.95 per hour. This compares with 10.94 per hour in the Lowry and Towles study, a drop of 1.99 behaviors per hour.

Since the 1987 study included only ABC, CBS, and NBC, it was necessary to make a direct comparison of these three networks, excluding the 1991 Fox network data. The overall rate per hour for these three networks was 9.57, a drop of 1.37 behaviors per hour.

INSERT TABLE 1 ABOUT HERE

Table 1 presents the detailed findings, so that longitudinal comparisons can be made for most of the categories. The largest drop occurred in the physical suggestiveness category---from 3.58 behaviors per hour in 1987 to .43 in 1991. Prostitution dropped from .89 to .36. Both categories of verbal references to intercourse (married and unmarried) increased, indicating that there was more talk about sexual intercourse in 1991, and intercourse/physical increased slightly. In keeping with the overall program totals for all behaviors, there was a parallel decrease in the subtotal for all other sexual behaviors---from 1.24 to .83 behaviors per hour. Erotic touching remained essentially unchanged. Thus a direct comparison of data from 1987 to 1991 showed a net decrease in sexual behavior in prime time programs.

In terms of pregnancy prevention and STD prevention, the totals for both of these categories showed declines from the already low rates in 1987. There were a total of two verbal references to someone coming down with HIV/AIDS, and two verbal references to someone acquiring a STD. However, all of these references were in a joking context; no one actually did acquire the diseases in our sample of programs.

Promos. The results of the analysis of program promos add considerable supplementary information to the analysis of the program content itself. There was a total of 451.5 sexual behaviors in the promos, amount to 5.14 per hour. This is all the more striking when one considers that there were, on the average, one minute and 45 seconds of promos per hour. The rate of physically suggestive behaviors per hour was .43 in the programs, and the rate of physically suggestive behaviors in the promos was almost the same (.41). Other categories with relatively high rates per hour in the promos were: erotic touching/unmarried (1.64), intercourse/unmarried/verbal (.77), and intercourse/unmarried/implied (.67). In fact, two categories, intercourse/unmarried/implied and homosexuality, had higher rates per hour in the promos than in the programs themselves. The grand total for all behaviors changes from 8.95 per hour to 14.09 per hour when promos are included.

Not shown in Table 1 are the totals for the individual networks. ABC was the leader in the rate of sexual behaviors per hour, with a combined total (programs and promos) of 20.82. This was more than twice the rate of Fox, which had 8.12 behaviors per hour. The scores for the other networks were NBC, 16.52, and CBS, 10.81. ABC was also the leader in sexual behaviors in 1987, even though that study did not analyze promos.

Discussion and Implications

Contrary to most public opinion, and contrary even to the opinions of some inside the television and advertising industries, the overall amount of sex on prime time network TV programs decreased substantially from fall 1987 to fall 1991. There was far less physical suggestiveness, but the total for heterosexual intercourse did increase from 1.77 to 2.93 behaviors per hour. One could hypothesize that this increase in intercourse-related behaviors was offensive to many observers and that they therefore perceived an increase in the total amount of sex on TV. This hypothesis deserves to be tested in future survey research on this topic.

The second purpose of this study---i.e., to analyze the rates of sexual behaviors in promos for prime time programs---was to our knowledge the first time that sexual behaviors in promos and programs have ever been analyzed in a single study. We believe that the extra effort was well justified by the results obtained. The networks are clearly using sex as "bait" in promos to attempt to increase their ratings. If future content analyses have the objective of measuring the overall amount of sex on TV, then promos must not be ignored. Based upon our study, to ignore promos is to ignore one-third or more of the relevant content.

What can be concluded about the networks' portrayals of pregnancy prevention, STDs and AIDS? Our results indicate that the 1986 criticisms of the Planned Parenthood Federation referred to above were still valid in 1991. The conclusion of this study is similar to the conclusion of Lowry and Towles' study of 1987 programs---i.e., Planned Parenthood was correct in charging that the networks seldom portray the possible consequences of sexual behavior.

As of fall 1991, the networks had yet to heed the appeal of the Secretary of Health and Human Services, a former medical college dean, to "turn down the volume on irresponsible sex."[28] And they had yet to heed the admonition of medical professor Robert C. Nobel, that "Unmarried people shouldn't be having sex."[29] In fact, adding the three frequency scores in Table 1 for married intercourse and unmarried intercourse reveals essentially no change in the ratio of unmarried intercourse to married intercourse (6.09:1 in 1987 and 6.13:1 in 1991). Therefore, the continuing message of prime time TV is that intercourse is primarily for unmarried partners.

These ratios pertain to the overriding message of the programs. What is the overriding message of the promos? The promos contained 2.5 instances of married intercourse and 126.5 instances of unmarried intercourse, for a much higher ratio of 50.6:1. And, since promos constitute only about one minute and 45 seconds per hour, this higher ratio is all the more striking.

One way to better appreciate the extent to which the promos are emphasizing sex to attract viewers is to adjust the promo total in Table 1 so that an "hour" of promos is the same length as an hour of program material, namely, 46:30. If this is done the hourly rate of 5.14 sexual behaviors per hour jumps to 136.3 per adjusted hour of promos, a rate more than 15 times higher (136.3/8.95) than the rate per hour of programs.

On one hand, the networks have reduced the total number of sexual behaviors per hour in their programs by a substantial amount in the four years spanned by this study. On the other hand, the results of this study indicate that the networks, in an effort to increase ratings, are emphasizing the sexual content of the programs in their promos. This finding supports the positions of physicians Sullivan and Noble that the wrong public health message is being sent to the nation---especially since promos are so brief that they almost never reveal the consequences of sex. The network promos used words and images of unmarried sex as one of their primary forms of enticement of viewers.

This country is experiencing unprecedented epidemics of teenage pregnancy, AIDS and other STDs. If television influences many viewers' attitudes, values and behavior (and the billions spent on TV advertising assume that it does), then the results of this study indicate that the sexual messages broadcast by the TV networks were certainly not part of the public health solution and may in fact be part of the problem.

TABLE 1
Frequency and Rate of Sexual Behaviors in 1987 and 1991 Prime Time TV

	1987 Programs		1991 Programs		1991 Promos	
	Frequency	Rate per hour	Frequency	Rate per hour	Frequency	Rate per hour
Suggestiveness						
Verbal	92	1.39	168	1.91	25.5	.29
Physical	236	3.58	37.5	.43	36.5	.41
Erotic touching						
Married	33.5	.51	48	.55	13.5	.15
Unmarried	130	1.97	176	2.00	144	1.64
Unclear status	--	--	--	--	8.5	.10
Subtotal	(163.5)	(2.48)	(224)	(2.55)	(166)	(1.89)
Heterosexual intercourse						
Married/verbal	11	.17	27.5	.31	1	.01
Married/implied	4.5	.07	7	.08	1.5	.02
Married/physical	1	.02	1	.01	--	--
Unmarried/verbal	84	1.27	179.5	2.04	67.5	.77
Unmarried/implied	15.5	.23	34	.39	59	.67
Unmarried/physical	1	.02	4	.05	--	--
Unclear status/verbal	--	--	5	.06	1	.01
Subtotal	(117)	(1.77)	(258)	(2.93)	(130)	(1.48)
Other sexual behaviors						
Prostitution	59	.89	31.5	.36	14	16
Aggressive sexual contact	5.5	.08	5	.06	45	.51
Homosexuality	9	.14	10	.11	15	.17
All other sexual behaviors *	8.5	.13	26.5	.30	6	.07
Subtotal	(82.0)	(1.24)	(73)	(.83)	(80)	(.91)
Pregnancy prevention	13.5	.20	9.5	.11	--	--
STD Prevention	18	.27	12.5	.14	1.5	.02
HIV/AIDS contracted	n.a.	n.a.	2	.02	12	.14
Other STDs contracted	n.a.	n.a.	2	.02	--	--
Total, all behaviors	722	10.94	786.5	8.95	451.5	5.14

Footnotes

[1] Planned Parenthood Federation of America, "They Did It 9,000 Times on Television Last Year," The Washington Post, Nov. 25, 1986, p. A18.

[2] Dennis T. Lowry and David E. Towles, "Prime Time TV Portrayals of Sex, Contraception and Venereal Diseases," Journalism Quarterly, 66:347-352 (Summer 1989), at p. 352.

[3] Louis W. Sullivan, text of a speech delivered to the 21st Century Commission on African-American Males, Washington, D.C., May 24, 1991.

[4] Lintas:USA, "Media Messages: Television 1991," Staying Relevant, January, 1991, p. 4.

[5] The Gallup Organization, Inc., "The Gallup Study of Television Viewing Habits: 1991," April, 1991, pp. 20-21.

[6] Geoffrey Cowley with Mary Hager, "Sleeping with the Enemy," Newsweek, Dec. 9, 1991, pp. 58-59, at p. 59.

[7] Ibid., pp. 58-59.

[8] Louis Harris and Associates, "American Teens Speak: Sex, Myths, TV, and Birth Control," poll conducted for The Planned Parenthood Federation of America, Sept.-Oct., 1986, p. 48.

[9] Arthur J. Kropp, "An Open Letter to . . . Studio and TV C.E.O.S," Daily Variety, March 12, 1991.

[10] "Senate Tells Fifth Estate to Clean up its Act," Broadcasting, June 5, 1989, pp. 27-28, at p. 27.

[11] Jon Krampner, "Nothing to Watch," Advertising Age, May 13, 1991, pp. S28-S29, at p. S28.

[12] Norm Alster, "Crude Doesn't Sell," Forbes, Jan. 21, 1991, pp. 60-61, at p. 60.

[13] Barna Research Group, "News Release," Aug. 22, 1991, p. 3.

[14] Donald E. Wildmon, "Normal Lear Says You Are Full of Bluster!" letter, n.d., 1991.

[15] Wayne Walley, "Advertisers 'up in Arms'," Advertising Age, Mar. 27, 1989, pp. 1, 68, at p. 1.

[16] Ibid., pp. 1, 68.

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[17] Scott Hume, "BK Resolves Boycott," Advertising Age, Nov. 12, 1990, p. 16.

[18] Cf. Susan Franzblau, Joyce N. Sprafkin and Eli A. Rubinstein, "Sex on TV: A Content Analysis," Journal of Communication, 27:164-170 (Spring 1977); L. Theresa Silverman, Joyce N. Sprafkin and Eli A. Rubinstein, "Physical Contact and Sexual Behavior on Prime-Time TV," Journal of Communication, 29:33-43 (Winter 1979); Bradley S. Greenberg, David Graef, Carlos Fernandez-Collado, Felipe Korzenny and Charles K. Atkin, "Sexual Intimacy on Commercial TV During Prime Time," Journalism Quarterly, 57:211-215 (Summer 1980); Joyce N. Sprafkin and L. Theresa Silverman, "Update: Physically Intimate and Sexual Behavior on Prime-Time Television, 1978-79," Journal of Communication, 31:34-40 (Winter 1981); Bradley S. Greenberg, Robert Abelman and Kimberly Neuendorf, "Sex on the Soap Operas: Afternoon Delight," Journal of Communication, 31:83-89 (Summer 1981); Dennis T. Lowry, Gail Love and Malcolm Kirby, "Sex on the Soap Operas: Patterns of Intimacy," Journal of Communication, 31:90-96 (Summer 1981); Carlos F. Fernandez-Collado and Bradley S. Greenberg with Felipe Korzenny and Charles K. Atkin, "Sexual Intimacy and Drug Use in TV Series," Journal of Communication, 28:30-37 (Summer 1978); Dennis T. Lowry and David E. Towles, "Soap Opera Portrayals of Sex, Contraception and Sexually Transmitted Diseases," Journal of Communication, 39:76-83 (Spring 1989); Bradley S. Greenberg and Dave D'Alessio, "Quantity and Quality of Sex in the Soaps," Journal of Broadcasting & Electronic Media, 29:309-321 (Summer 1985); Barry S. Sapolsky and Joseph O. Tabarlet, "Sex in Primetime Television: 1979 Versus 1989," Journal of Broadcasting & Electronic Media, 35:505-516 (Fall 1991).

[19] Lawrence C. Soley and Leonard N. Reid, "Baiting Viewers: Violence and Sex in Television Program Advertisements," Journalism Quarterly, 62:105-110, 131 (Spring 1985); Gilbert A. Williams, "Enticing Viewers: Sex and Violence in TV Guide Program Advertisements," Journalism Quarterly, 66:970-973 (Winter 1989); Donald M. Davis and James R. Walker,

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"Sex, Violence and Network Program Promotion: A Content Analysis," paper presented at the annual meeting of the Speech Communication Association, Atlanta, Nov. 1991.

[20] Lowry and Towles, "Prime Time TV . . . ," op cit., p. 351.

[21] Louis Harris and Associates, "Sexual Material on American Network Television During the 1987-88 Season," Jan. 26, 1988, p. 7.

[22] Planned Parenthood Federation of America, "They Did it 9,000 Times . . . ," op cit.

[23] Robert C. Noble, "There Is No Safe Sex," Newsweek, April 1, 1991, p. 8.

[24] Lowry and Towles, "Prime Time TV . . . ," op cit.

[25] Silverman, Sprafkin and Rubinstein, op cit.

[26] Louis Harris and Associates, 1988, op cit.

[27] A copy of the complete coding manual is available from the authors.

[28] Sullivan, op cit.

[29] Noble, op cit

Reading Risk:
Public Response to Print Media Accounts of Technological Risk

Paper Presented at Annual Meeting

Association for Education in Journalism and Mass Communication

Montreal, Quebec, Canada

August 1992

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Reading Risk:
Public Response to Print Media Accounts
# of Technological Risk

ABSTRACT

Two clearly defined positions on the evaluation of technological risks have emerged in the scholarly literature in a variety of disciplines: a "rationalist" perspective and a "subjectivist" perspective. This paper argues from a subjectivist position that differences between scientific and lay responses to risk information (as presented in media accounts) are not necessarily generally attributable to "misinterpretations" by nonscientific readers, and that the process through which lay publics interpret mass media accounts of risk is worthy of more study. Data are presented from twenty focus groups discussions, involving 114 student respondents, of a range of print media articles about risky technologies. The results suggest that lay publics work with an "expanded vocabulary of risk" that takes into account a variety of issues having to do with information, implementation, regulation, and ethical considerations, as well as the cost and benefit factors traditionally weighed by risk assessors. The scientific community needs to recognize that the public expects this kind of broader accountability, and media accounts need to be written to respond to needs in these areas.

Reading Risk:

Public Response to Print Media Accounts of Technological Risk

> All breathing generates oxygen radicals, which are the main sources of mutations in DNA . . . . Breathing has been observed 3 minutes before death in 100% of all fatalities.
>
> --Dr. Noitall, fictitious risk expert quoted in Science magazine editorial, June 30, 1989

> These people have to be very credited just to be in the NIH in the first place. So they know what they're doing.
>
> --Respondent in this study

Risk is a political issue. In a post-industrial democracy, confronting the social acceptability of the risks of emerging technologies is an everyday form of crisis. Public opinion, media representations, and the actions of government officials interact in complex and uncertain ways, as they do for all political issues (Lang and Lang 1983). Complicating this interaction in the case of risk issues, however, is the special status of expert scientific opinion within the debate. On the one hand, scientific opinion is idealized as objective and disinterested; on the other, science itself--especially science in the service of technology--carries its own institutional biases and interests (Dickson 1984). At the same time, the mythology of science as impartial truth means that scientific testimony carries great rhetorical weight. Advocates of diverse political positions on risk policy issues thus put scientific opinion to uses alien to its hypothetically disinterested foundations. The public contours of this dialogue are shaped largely through mass media discourse on particular issues as they rise and fall on the popular agenda.

Two clearly defined positions on the evaluation[1] of risks have emerged, which I will term the "rationalist" and the "subjectivist" positions for purposes of this discussion. These positions incorporate sharply (but often implictly) differing assumptions about the nature of scientific opinion in relation to the determination of levels of risk. The rationalist position holds that it is theoretically possible, if sufficient data could be collected and various technical problems of analysis solved, to arrive at an absolute measure of the riskiness associated with any given technological innovation. This theoretical measure becomes the yardstick against which both public opinion and media representations are judged. Advocates of the rationalist view regularly point out that the nontechnical public has difficulty understanding probabilities, especially very small ones, and that their reactions to risk information are therefore often "distorted" vis-a-vis the "correct" ones. The public accepts some large risks willingly, while balking at others judged vanishingly small. While rationalists are not necessarily anti-democratic, they are concerned that these systematic "distortions" be corrected by public education so that citizen participation in risk-related decision-making is based on knowledge rather than ignorance. For example, Zeckhauser and Viscusi (1990) ask, "How should we proceed once we admit that individuals do not correctly react to many risks?" (p. 560; emphasis added). From this position media accounts of risk are typically judged on how accurately they reflect the scientific point of view and how well they contribute to public education designed to eradicate wrong thinking.

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[1] The term "evaluation" is used in preference to either "perception" (which implies distortion) or "assessment" (which implies objectivity) for reasons that will become clear further on in this discussion.

The subjectivist view began taking shape with the publication of Slovic et al.'s (1979) psychometric studies of risk perception, which demonstrated that a variety of factors other than probability of harm influence public perceptions of risk. Although studies in this tradition sometimes waver between a rationalist and a subjectivist stance (Bradbury 1989), they represented the first strong statements to the effect that the evaluation of risk information takes place in a social context and involves value judgments and priorities--that is, that this process is inherently subjective. This point of view is apparent in the literature on the sociology of risk, which--drawing in a general way from analyses of other social problems such as crime--is highly sensitive to the influence of the social definitions given social issues. For example, Stallings (1990) points out that from a sociology of risk perspective, "risk and safety are not objective conditions 'out there' simply waiting to be perceived by citizens or calculated by professional risk analysts" (p. 80) and that "'data' for assessing risk do not exist independently of human observation nor do they interpret themselves" (p. 91). The focus of research from this perspective is on the social process through which particular definitions of risk are constructed; the media figure prominently in this picture, as they vocalize and therefore legitimize some points of view (often those of established institutional news sources) and ignore others. A variety of subtle aspects of the ways in which emerging issues are shaped and defined support particular institutional interests, as Plein (1991) illustrates for the case of biotechnology. News accounts inevitably contribute to definitions-of-the-situation that serve some interests in preference to others, the journalistic ethic of objectivity (which echoes in interesting ways the rationalist notion of risk) notwithstanding.

A subjectivist stance is also evident in the anthropological literature on risk. For example, Wildavsky and Dake (1990) present evidence that risk perceptions are strongly influenced by what they call the "cultural biases" of the perceiver. Although this study (drawing from the work of Mary Douglas and others) defines culture quite narrowly in terms of hierarchical versus individualistic versus egalitarian worldviews, the chain of logic linking support for a particular way of life with acceptance or rejection of particular forms of risk is clear--and clearly subjectivist. Given that other research has established that the mass media also reflect systematic ideological biases (pro-individualist and pro-capitalist; Gans 1979), it is little wonder that media accounts are often blamed (from a rationalist perspective) for distorting and politicizing "technical" risk issues. But they are also blamed (from a subjectivist perspective) for overrepresenting the scientific point of view--for acting as publicists for establishment science (Nelkin 1987). Just as liberals find the press too conservative and conservatives find the press too liberal, risk reporting seems destined to please no one--a problem that is much deeper and more difficult than a question of whether scientific and environmental journalists get their technical facts straight, or whether media accounts are pro- or anti-technology.

There are special problems associated with media reporting of science generally, and with reporting on risk in particular. We know, for example, that nontechnical ("lay") publics have difficulty distinguishing between mainstream and fringe opinion on scientific matters (Turner et al. 1986). At the same time even those journalists sophisticated in their approach to science may have difficulty locating appropriate expert sources on deadline. Some of the earliest mass communication research suggested that over time, low-credibility sources may be as influential as high-credibility sources (Hovland et al. 1953), so that even where sources are identified as nonexperts, in the long run the information may have the same effect as information from an expert source. In fact, Mazur (1981) has presented evidence that any media coverage of science, whether positive or negative in tone, is followed by negative public opinion, a proposition that received additional support in a more recent empirical test (Wiegman et al., 1989). We know from several decades of research on the agenda-setting influence of the media (McCombs and Shaw 1972; Iyengar and Kinder 1987) that the degree of public attention to issues is sensitive to the degree of media attention, and Mazur's results may be reflective of this process. By focusing the public's attention on a risk issue, no matter what is actually said about it, the media may be inviting their audience to be concerned. However, even a superficial analysis of how news media in the United States operate leads to the conclusion that they tend to follow controversy, both to increase their audiences (sensationalism) and because one of their legitimate roles is to alert the public to dangers and wrongdoing (surveillance function [Lasswell 1948] or "watchdog role"). Given that only controversial issues tend to be covered, the finding that a rise in coverage is associated with a rise in public concern is in itself unremarkable.

In any event mass media accounts do not determine public opinion. The entire history of media research at it has emerged as an independent discipline in this century is a history of movement away from simplistic one-way ("magic bullet") models of how media content might influence public opinion (for reviews of this history see Defleur and Ball-Rokeatch, 1989; Lowery and DeFleur 1988). Contemporary mass media effects research is sensitive to the influence of powerful institutional interests on the media, as well as of the media on the public (Gandy 1982). It recognizes that the power of the media lies less in dictating opinion, however, than in setting the agenda of public concerns (as discussed above) and in defining or "framing" issues (Tuchman 1978), and that media effects may be best understood as longterm and subtle influences on our understanding of the world (Gerbner and Gross 1976). Furthermore, this research is sensitive to the preexisting cognitive dispositions audiences bring to bear on the processing of new information (Graber 1988), and to the way mass media information is diffused through and interpreted within a social network (Katz and Lazersfeld 1955; Rogers 1983).

Yet missing from most discussions of the influence of the mass media on public perceptions of risk--often written independently of the more general literature on media effects--is any evidence of how people actually respond to media information in this area. This study is an attempt to extend our understanding of the social construction of risk by examining how lay (nontechnical) publics actually interpret mass media (print journalism) accounts of risky technologies. The study is based on the subjectivist premise that levels of risk do not meaningfully exist independent of a given interpretive context, and that the way to better understand public reactions to risk information is not to measure their degree of divergence from the "correct" interpretations but to take seriously the study of the arguments that underlie actual people's evaluations in situations resembling natural social interaction.[2] The study is exploratory and not intended to be conclusive, but the data argue that misinterpretations of scientific data on levels of risk (narrowly defined) are less important explanations of public reactions to risk information than are attentiveness to such factors as the need for additional research, the adequacy and validity of available information, whether regulatory mechanisms are in place, economic impacts, and the availability of alternatives. That is, lay publics (as represented by the respondents in this study) work with an "expanded vocabulary of risk" that takes into account a broader and in a sense a more sophisticated range of factors than do rationalist measures of risk. The result is risk evaluations that may certainly be different from rationalist measures but that are not thereby "irrational."

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[2] This study thus "brackets" or sets aside, as the phenomenologists would say, the issue of absolute truth, and approaches instead the issue of how relative truths emerge, or are constructed, in social interaction. The approach of this study is thus parallel in theory, although not necessarily in method, to that of ethnomethodology or interpretive sociology (Pollner, 1974). The results should be as useful for those embracing a rationalist conception of risk as for those embracing a subjectivist conception, however, since rationalist approaches to public education need to be grounded in how people actually think.

Methods

Because of the known importance of interpersonal discussion to the interpretation of mass media information, and in order to generate a data set consisting of statements about risk made in response to mass media accounts, a focus group methodology was chosen. Twenty groups of from four to eight undergraduate student volunteers[3] from journalism classes were utilized in this study. (Four additional group discussions were conducted but eliminated from the study due to technical problems with the audiotapes.) Each group was assigned the task of evaluating a risk-related technology based on a single print journalism (newspaper or magazine) article. The groups were asked to put themselves in the position of having been chosen to participate in a citizen's advisory council to an agency of the government, and to discuss and decide among themselves the recommendations they would make. They were asked to arrive at a specific position on the question of whether the process, procedure or technology described in the article was safe enough for unlimited use, for limited or qualified use, or for no use at all. They were asked to be sure they could provide some justification for their position. A post-discussion questionnaire also asked each participant individually to evaluate the level of risk they personally associated with the technology, to indicate the consensus decision of their group, and to state the three arguments they felt were of most importance to the group. They were also asked to state their own personal position on the use of the technology and to give the three arguments they personally felt were the most important. The post-discussion questionnaire also included standard demographic items (age, gender, ethnicity, parents' household income), plus year in college and major.

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[3] The students received extra credit points for participating. The problems of using students in studies intended to represent general populations are well known. However, by far the majority of these students were beginning journalism majors, who typically take no more than a few elective courses in science at the college level and who are probably not (at least at the beginning of their studies) much more sensitive than the general population to the problematic character of media representations of reality.

Eight different articles were used in this study. They were chosen from media accounts current at the time the study was initiated, in both magazines and newspapers. The criteria for selection were simply that each article be about the same length (approximately filling a standard letter-size piece of paper) and that it be about a technology with which some degree of risk was clearly associated. In addition, an attempt was made to identify articles that represented the broadest possible range of risky technologies. The final article set covered these topics: flouride in drinking water, electromagnetic fields surrounding computer monitors, post-menopause estrogen therapy, mercury in dental fillings, burial of nuclear waste in New Mexico caves, milk production using bovine somatotropin (a dairy cow hormone), human gene therapy, and the Phillips Petroleum plant explosion.

The articles were chosen from the Dallas Morning News, the New York Times, the Chicago Sun-Times, the Bryan/College Station Eagle (a local Texas paper), Time and Newsweek. The articles varied as to tone from sensationalist ("Scientists criticize human gene therapy") to political ("Foes of bovine somatotropin plan boycott") to cautiously reasoned and fairly technical ("The risks of fluoride: A long-awaited verdict"). Thus it is entirely possible that the tone and "frame" of the particular stories used conditioned some aspects of the focus-group reactions. No attempt was made to control for this, because the number of factors that might be identified as potentially influential is indefinitely high. Data on overall level of risks perceived (see below) suggest that level of risk seen was more responsive to the type of risk described than the way in which that description was framed. However, the intent of this study was not to measure relationships between particular media treatments and the responses of nontechnical publics but to draw general conclusions about how those publics evaluate risks, and the inclusion of a range of styles as well as topics was considered more important than controlling for this factor.[4]

Altogether, 114 respondents participated in the 20 discussion groups. Respondents were assigned to groups by asking them to sign up in large lecture classes for times that fit their class schedules. (Under this constraint, random assignment was not practical, but this procedure should not have introduced systematic biases.) Either two or three groups considered each of the eight issues. Issues were assigned to groups systematically. All group discussions were tape recorded, and the tapes transcribed word-for-word. The transcripts were then coded using a procedure described as "grounded theory" by Glasser and Strauss (1967). That is, the categories to be used were allowed to emerge from the data rather than being imposed a priori by the researcher. The unit of analysis was the argument. All coding was done by a single research assistant, who had to make a judgment about when one argument ended and the next began. A total of 361 arguments were identified in this way. Two randomly selected transcripts were recoded by the same assistant as a reliability check; the 33 arguments originally identified in these transcripts were recoded with a different code only 10% of the time, although there were an additional ten instances of differences in deciding where an argument began or ended that sometimes resulted in differences in what code or codes were assigned. The unit of analysis is thus problematic, although the categorization of arguments held up well under this recheck procedure. However, results from the post-discussion questionnaire, which will be presented below, present a substantially similar picture of arguments felt to be important, both for the groups and from the perspective of individual respondents. The same codes that evolved through the analysis of the transcripts were used in the analysis of the questionnaire data. Finally, individual argument types were grouped together for further analysis, as were results for high-, medium-, and low-risk technologies.

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[4] Media frames do, however, influence evaluations of risk. See, for example, Hornig 1990a; 1990b.

Results

Overall judgments of risk levels from the post-discussion questionnaire are presented in Table 1. On the basis of divergence in mean risk seen for each issue from the grand mean, the issues used were grouped as shown, with those with mean risk levels more than one-half standard deviation above the grand mean classified as high risk and those the same distance below defined as low risk. Interestingly, this produced groupings clearly distinguishable on the basis of type, with large-technology risks of catastrophe seen as high, biotechnological and medical risks seen as medium, and pervasive risks from smaller-scale, more familiar technologies seen as low, although of course the range of risks presented was not great enough to draw conclusions here.

Table 2 presents the full range of argument types present in the transcript data and illustrates the way in which individual argument types were grouped for further analysis. Table 3 compares these with results for the post-discussion questionnaire items giving arguments felt to be important, with the arguments listed first, second, and third combined. (The questionnaire did not request a rank-ordered list, but asked for the three most important arguments.) Ethical and regulatory issues are slightly overrepresented in the transcript data in comparison to the post-discussion questionnaire data, perhaps because these issues are (or are seen to be) more complex or more subjective, calling for more discussion. Overall, however, the questionnaire data did not diverge markedly from the pattern suggested by the transcripts, confirming that the coding procedure produced results consistent with the perceptions of group members. Since the arguments listed as most important for the groups and for the individuals were distributed almost identically, the latter arguments will not be considered further. (Many respondents simply copied their responses to the question about group arguments in answer to the question about individual arguments. However, these results still suggest a high degree of group consensus about what issues were seen as important.)

Tables 4 and 5 show how arguments presented (using transcript and questionnaire data, respectively) varied by risk level group. The pattern of distribution of arguments is different for the low-, medium-, and high-

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risk issues used, with information concerns (based on the Table 5 questionnaire data) most strongly dominating the low-risk group (55 percent of arguments), dominating the medium-risk group but to a more limited extent (29 percent), and accounting for only 10 percent of the arguments in the high-risk group. Benefits similarly represent 18 percent of the low-risk group arguments but 11 percent of the medium-risk group and only 2 percent of the high-risk group arguments. Impacts, on the other hand, account for only 4 percent of the low-risk group arguments but 19 percent of the middle-risk group and 34 percent of the high-risk group arguments. Implementation, regulation, and ethics concerns also appear to rise with increasing risk. These patterns probably spring from a variety of factors in addition to level of risk, such as familiarity and comfort with particular technologies and past exposure to information about some of the risks. (A roughly similar, although more ambiguous, pattern appears in the transcript data in Table 4; the relationship between perceived importance of an argument and its appearance in discussions is clearly an imperfect one.)

The most frequently encountered argument group in the transcript data overall was that of information issues. This included arguments about research adequacy ("I think this needs a lot more testing"; "The whole last paragraph is saying we need to do more studies"), about the sufficiency of the information contained in the articles ("Maybe we should try and see if there would be any more information"; "It doesn't seem like there's enough information"), the validity of the evidence ("So they should find out if all that is valid before they even start doing it on humans"; "There isn't proof that this is true"), and the credibility of sources ("I'd like to know where he's backed from"; "I mean this is Newsweek!"). The concern with information is on the one hand not surprising, since the groups were asked to arrive at a decision on the basis of information contained in a single, relatively brief, article. At the same time, this pattern is not supportive of the view that readers and audiences tend to jump to conclusions on the basis of inadequate evidence. Rather, they reflected strong awareness of the limitations of the available information. If readers seem to behave conservatively (i.e., are unwilling to accept a risk or tend see a greater threat) where they are not provided with enough credible information about an issue, it may be awareness of that information's limitations, not a tendency to over- or misinterpret it, that is involved. This hypothesis deserves further study. Collectively, concerns about information accounted for over one-fourth of all arguments.

The second most frequently encountered category involved negative impacts, whether on human health ("You have the chance of getting . . . cancer"; "Side effects might come later"), the economy ("We have enough economic problems with farmers how it is"; "They didn't mention how much it costs"), the environment ("Test until [they] make sure it's safe so it won't pollute the environment"; "There's also a bunch of really rare life forms in that area"), or other potential dangers, including arguments about the number of people who would be involved and the specific locations that would be affected. This category is consistent with the "cost" side of cost-benefit analysis. It is important to note that these discussions did not revolve around the mathematical probability of harm, however, but around the types of impacts that might be anticipated and whether they could be ruled out. Within this category, human health risks (among the narrowest of the scientific definitions of risk) were the most common category of argument, but still only accounted for less than nine percent of the arguments overall. Negative impacts as a whole made up about one-fifth of the arguments coded.

Discussions of benefits and alternatives made up the third largest category--the "benefit" side of cost-benefit analysis. Within this category, the availability of alternatives ("There are alternatives to silver fillings"; "There's other drugs you can take that don't give you the same risks") was most prominent, followed by priority-of-need arguments ("I think it should be used on people who are desperate and are dying anyways"; "I think we need to find out exactly how the girls is doing [first]") and arguments about potential benefits ("Think about it if you didn't explore and find things like insulin"; "So it shouldn't be . . . banned because then a lot of women took it and got good use out of it"). But the discussions did not dwell on considerations of benefit per se, which accounted for under three percent of all arguments. This may have been a function of the instructions to the groups, which asked for an assessment of risk and its acceptability rather than benefit, but it also suggests that the extent to which benefits are brought into play in media accounts about new technologies might be worth further exploration. Altogether, discussions of benefits and alternatives accounted for only thirteen percent of the arguments.

Implementation issues, which accounted for an additional twelve percent, and regulatory issues, at eleven percent, were treated separately in the data analysis but are in some ways similar. If combined, they would have represented the second largest argument category, ahead of both negative impacts and benefits and alternatives and behind only information issues. The implementation issue group reflects concern with communication issues: whether affected individuals have been informed of the risks and allowed a choice ("I think it should be her decision"; "If they published stuff like this, . . . then it's your own personal choice"), whether the public has been informed ("We probably wouldn't know . . . if the hormone [was] in the milk anyway unless we read the back"; "They should at least make it public knowledge"), and whether proper safety precautions were taken and workers in potentially dangerous situations appropriately trained. Regulatory issues, the largest single category of argument, represented concern over mechanisms for control of of use ("Maybe the government should regulate it instead of the company"; "Should there be regulations that the doctor has to warn patients?"). These arguments collectively reflect strong sensitivity to the broader social context in which risks are assumed and managed.

A third category concerned with social issues was the category of ethical considerations, including both arguments about motives ("It's just another little thing to make money off of for the corporate producers"; "This study could have been sponsored by a bottled water company") and issues of right and wrong ("But even at that was it right of them to even put it in her in the first place?"). This category by itself accounted for just under one-tenth of the arguments, but (again) had it been combined with implementation and regulatory issues under the heading of social considerations this would have been the largest single category of argument, exceeding even information issues. The data thus strongly indicate the prevalence of a broad view of the notion of risk, a view that takes many "rational" arguments into account that cannot be contained within either a probability-of-harm model or a cost-benefit model of risk evaluation.

Isolated cases of misinterpretation of mathematical information did emerge in the data, but were simply not a characteristic theme. For example, in one discussion of the fluoridation issue the question of dosage was raised, and respondents questioned why research on rats would use doses of several tens of parts per million when four parts per million is the legal limit, reflecting a lack of background knowledge on standard procedures and necessary compromises in short-term animal toxicology research intended to be generalizable to long-term human effects. Even in this case, however, the interpretation of evidence in itself did not seem to control the group decision. Rather, respondents seemed willing to rely on expert opinion for the interpretation of technical evidence, although questioning the objectivity and the adequacy of both expert and evidence. In short, they wanted more information.

The use of analogy to other, apparently unrelated technologies in the discussions suggests that people do generalize about technology and the status of scientific information, although this type of argument was not common enough to emerge as an independent theme. For example, in the discussion of fluoridation mentioned above, one respondent used the analogy of dietary recommendations:

> Because they always, like at first they said . . . eat a lot of bran, and then they said don't eat bran just don't eat fat, and then don't

> eat [avoid?] fat avoid cholesterol. It's just every couple of months it changes so you'd have to wait until something new came out.

Or again, regarding gene therapy:

> I think these other guys are saying that these fellows that are doing this are trying to get in the first shot. That could probably be substantiated because remember the cold fusion thing and everything? Everybody thought they had that and everybody went after it and then nobody had it.

A certain level of cynicism about the status of individual media reports of specific findings is thus suggested. While it might be worrisome (from a rationalist perspective) that interpretive analogies are made between scientific findings in entirely different areas, these respondents exhibited some degree of immunity to the undue influence of isolated findings of risk in any given case.

Sometimes personal experience was called upon: "Do any of y'all that have fillings experience PMS or food allergies or anything?" This question was greeted with laughter, but still represents an attempt, rhetorically, to argue that if the risk were great, it would have resulted in personal experience with its impact. Personal experience, and that of acquaintances, was also used to argue for the presence of risks:

> Well, I worked construction over the summer [on a] big shopping mall, and I know things that are supposed to get inspected don't get inspected.

And:

> A friend of mine [is] co-oping in a chemical plant in Pasadena. And he told me that [the] place is gonna blow up any day . . . . He said all the time those alarms are ringing.

Arguments of this type are thus used both to credit and to discount--but in any event to interpret--media accounts of risk.

Occasionally analogies with fictional media portrayals also emerged: "Yeah, in all the movies I've seen they switch to the control room." Such comments most often seemed to be intended humorously, or at least ironically, but still suggest how media images, even fictional ones, contribute to the type of general understanding of science and technology that shapes the interpretation of new information. While responses to risk information are not narrowly responsive to misinterpretations of statistical information, then, they are broadly responsive to a generalized conception of the reliability of science, of technology, and of mass media information, which both personal experience with technologies and interpersonal communication, as well as previous media exposure, help to construct.

In deciding specifically between a recommendation for limited use, for unlimited use, or for no use at all, 13 of the 20 groups opted for limited use. In a general way, the level of use recommendations were congruent with the relative level of risk seen. The four groups that evaluated the two lowest-level risks (fluoridation and electromagnetism) recommended unlimited use, and one of the three groups that evaluated the highest-level risk (nuclear waste) recommended no use. However, one group opted for unlimited use of a mid-level risk (estrogen), and one opted for no use of such a risk (BST). (All other mid-level risks were recommended for limited use.) Degree of risk is thus associated, although imperfectly, with acceptability. The dominant theme in the discussion of the group opting for unlimited use of estrogen therapy seemed to be that the decision had to be left up to the recipient, who would have to be informed of the risk, until further research was completed. The dominant theme in the discussion of the group opting for no use of BST was that more testing was called for, given that a need for the drug had not been established. Thus both groups of respondents balanced issues such as need and informed consent against risk in arriving at a recommendation, consistent with the general trends apparent from examinatino of Table 2. Only 12 of the 114 respondents' individual level-of-use recommendations differed from the respective group recommendations.

Discussion

These data strongly support the assertion that public concerns about technological risk do not depend heavily on numerical representations of the probability of harm (whether interpreted "rightly" or "wrongly") so much as on attention to a broad variety of considerations related to how technologies will fit into and be controlled within the social system: the technologies' compatibility with ethical principles, procedures for their regulation, whether potential or alleged risks are undertaken knowingly or unknowingly, and so on. The results are compatible with other research by the author (Hornig, 1992) that indicates--on the basis of an entirely different methodological approach--that attitudes about how science and technology are controlled are better predictors of risk levels seen than are cost-benefit considerations, judgments about effects, or concerns over how science and technology are used.

These concerns, as studied here in a context intended to simulate real-life decision-making situations, are fully "rational" and generally well-articulated, especially considering that the respondents were undergraduate students with no special training in science. Concern with the quality and adequacy of the scientific evidence as presented in individual media accounts was high, but jumping to conclusions on the basis of inadequate or misinterpreted evidence was simply not characteristic of the discussions. Mass hysteria in response to pseudoscientific projections does occur under some conditions, as evidenced by events ranging from the well-documented reactions to fictional descriptions of an alien invasion in Orson Welles' 1938 War of the Worlds radio broadcast (Cantril 1940) to--by all accounts--the more recent reactions to predictions of a catastrophic earthquake for New Madrid, Missouri. But such reactions seem to be dependent on special circumstances (such as rumor transmission within a local social network) and do not describe the behavior of respondents in this study.

What are the implications of these results for media professionals and for the scientific community concerned with public opinion? The facilitation of informed democratic dialogue about the wisdom of adopting certain technologies calls for responsiveness to the concerns of the public. Media accounts of probabilities of harm should be accurate, but accurate reporting of risk information in the narrower senses of this term is not enough. This study presents evidence that risk evaluations are made in large part on the basis of social context considerations; media accounts must be responsive to the information needs that this implies, and the scientific community must recognize that public responses to risk involve more than responses to technical evidence. Where the scientific community believes that a technology is potentially of great benefit, that it has been adequately tested and will be adequately monitored in use, and that any risks have been explained to those who will be exposed to them, these are the messages it needs to put forth. Responsible media coverage must address these issues as well, taking proactive steps to explore them where necessary and probing for weaknesses along these lines as well as strengths. No amount of information on probabilities of harm--however phrased--will serve to create a favorable climate of public opinion unless social context issues are also addressed. Where they have not been addressed (either in actuality or in media representations of that actuality), public pressure to address them is likely to continue, and lay evaluations of risk will continue to be responsive to the deficit.

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Table 1. Mean risk levels seen for issues presented (post-discussion questionnaire item, seven-point scale ranging from 1 = not risky at all to 7 = extremely risky).

	N	Mean risk	S.D.
High-risk issues			
Nuclear waste	16	6.25	1.06
Petroleum plant	16	6.06	1.00
Medium-risk issues			
Gene therapy	21	5.38	1.12
Estrogen treatment	11	4.82	1.08
Bovine somatotropin	16	4.56	1.79
Low-risk issues			
Mercury fillings	14	3.43	1.02
Electromagnetic fields	10	2.90	1.45
Fluoridated water	10	1.80	0.63
All issues	114	4.66	1.81

Table 2. Arguments coded from transcript data showing frequency distribution and argument groups (N = 361).

	Frequency	Percentage
Information issues		
Research adequacy	31	8.6%
Information sufficiency	31	8.6
Validity of evidence	21	5.8
Source credibility	15	4.2
All information issues	98	27.2
Negative impacts		
Human health risks	29	8.0
Economic issues	18	5.0
Environmental threats	8	2.2
Other potential dangers	8	2.2
Number people affected	3	0.8
Location affected	1	0.3
All negative impacts	67	18.6
Benefits and alternatives		
Availability of alternatives	25	6.9
Priority of need*	12	3.3
Potential benefits	10	2.8
All benefits/alternatives	47	13.0

Table 2 (continued).

	Frequency	Percentage
Implementation issues		
Individual awareness	23	6.4
Public awareness	8	2.2
Safety precautions	8	2.2
Worker training	4	1.1
All implementation issues	43	11.9
Regulatory issues	39	10.8
Ethical considerations		
Motvations	17	4.7
Right and wrong	16	4.4
All ethical considerations	33	9.1
Other		
No problem exists	26	7.2
Already in use	1	0.3
Other	7	1.9
All other	34	9.4

*For medical treatment, e.g., is patient terminally ill?

Table 3. Comparison of arguments coded in transcript data (N = 361) with arguments listed as among three most important from group and from individual perspectives (N for respondents = 114; N for arguments = 342).

		Post-discussion questionaire data	
Argument group	Transcript data frequency (%)	Group argument frequency (%)	Individual argument frequency (%)
Information	98 (27.2%)	107 (31.3%)	104 (30.4%)
Impacts	67 (18.6)	64 (18.7)	66 (19.3)
Benefits	47 (13.0)	36 (10.5)	33 (9.6)
Implementation	43 (11.9)	46 (13.5)	38 (11.1)
Regulation	39 (10.8)	21 (6.1)	24 (7.0)
Ethics	33 (9.1)	13 (3.8)	20 (5.8)
Other/missing	34 (9.4)	55 (16.1)	57 (16.7)

Table 4. Argument group frequencies (percents) by risk-level categories (transcript data).

	Low-risk	Medium-risk	High-risk
Information	31 (25.8%)	60 (39.5%)	7 (7.9%)
Impacts	29 (24.2)	15 (9.8)	23 (25.8)
Benefits	18 (15.0)	25 (16.4)	4 (4.5)
Implementation	14 (11.7)	15 (9.9)	14 (15.7)
Regulation	6 (5.0)	10 (6.6)	23 (25.8)
Ethics	5 (4.2)	15 (9.9)	13 (14.6)
Other/missing	17 (14.2)	12 (7.9)	5 (5.6)
	120	152	89

Chi-square = 75.45, df = 12, P $\leq$ .005.

Table 5. Argument group frequencies (percents) by risk-level categories (group arguments from questionnaire data).

	Low-risk	Medium-risk	High-risk
Information	56 (55.0%)	41 (28.5%)	10 (10.4%)
Impacts	4 (3.9)	27 (18.8)	33 (34.4)
Benefits	18 (17.6)	16 (11.1)	2 (2.1)
Implementation	10 (9.8)	16 (11.1)	20 (20.8)
Regulation	0 (0.0)	9 (6.3)	12 (12.5)
Ethics	2 (2.0)	5 (3.5)	6 (6.3)
Other/missing	12 (11.8)	30 (20.8)	13 (13.5)
	102	144	96

Chi-square = 90.81, df = 12, $P \leq .005$.

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Strategies of Evasion in Early 17th Century French Scientific Communication

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AEJMC-Montreal 1992

LIST OF ABBREVIATIONS

MC	*Correspondance du Père Mersenne*.
PC	*Les correspondants de Peiresc: Lettres inédites, publiées, et annotées*.
PL	*Lettres de Peiresc*.
PV	*Correspondance de Peiresc avec plusieurs missionaries et religieux de l'ordre des capuchins, 1631-1637*.

Author's Note:

Due to a family emergency I am unable to attend this poster session. I would be interested in receiving comments from readers -

-JJJ

Cover and poster art by Margaret Ross Tolbert

Following the condemnation of the Dialogue Concerning the Two Chief World Systems in 1633, the French magistrate Nicolas-Claude Fabri de Peiresc advised that letters to Galileo be written in vague terms so as not to be misconstrued by "ill-intentioned and ill-informed people."[1] On other occasions, Peiresc recommended addressing envelopes to powerful patrons so as to avoid problems with the Inquisition.[2]

In seventeenth-century France, censors controlled official channels of communication. Expression of views conflicting with the traditional textual authorities of Aristotle or the Scriptures could result in punishment ranging from forced retractions and book burning to an occasional execution. There was a tendency in France to obliterate any vestige of the crime--be it the text or individual.[3]

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[1] Peiresc to Gassendi, 5 Jan 1634, PL 4: 408.

[2] Peiresc to Holstenius, 8 June 1629, PL 5: 336.

[3] Alfred Soman, "Press, Pulpit, and Censorship in France Before Richelieu," Proceedings of the American Philosophical Society (Philadelphia: The American Philosophical Society, 1976), 452.

Censorship and The New Science

The rhetoric of the new science emphasized empiricism as opposed to the traditional reading of the Scriptures and Aristotle. Galileo's telescopic observations revealed that the moon was not a perfect celestial globe but marked with mountains and craters. The prospect that the moon resembled the earth and that surface of the sun was not immutable contributed to the overthrow of the Aristotelian and Platonic world-view which upheld the distinction between the lunar and supra-lunar realms. To protect the authority of the Scriptures and the hierarchy of being, the church implemented censorship and revived the Inquisition.[4]

The extent of censorship varied throughout Europe. The exchange of information was often greater in the politically-fragmented countries, such as in the German states, where there was no central control of communication. In certain parts of Italy, church officials inspected publications. In Florence, editors were protected by scholarly princes, while Padua, located in the anti-papist state of Venice, became an intellectual center of Europe.[5] Holland and England provided a relative haven for writers and publishers.[6]

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[4] Peter Dear, "Totius in verba: Rhetoric and Authority in the Early Royal Society," Isis 76 (1985): 146.

[5] John Herman Randall, Jr., "The Development of Scientific Method in the School of Padua," Journal of the History of Ideas 1 (1940): 184.

In France, a council of inquisitors composed of members of Parlement and theologians of the Sorbonne examined and censored all religious works prior to publication. If the content was acceptable, the Sorbonne granted a permit to print.[7] By the mid-sixteenth century, the French government inspected presses[8] and importations from Protestant countries. By 1563, authors, editors, and publishers of newspapers needed a privilege or copyright as well as a permit from the censors. But a permit did not always safeguard writers and editors. Giulio-Cesare Vanini was burned at the stake in Toulouse on 9 February 1619 for his works in astrology and his criticisms of the miracles of the church.[9] Vanini had received a permit to print from the Sorbonne only six years earlier.[10] While Vanini was burned, another individual charged with a similar crime was only exiled from Paris--a discrepancy in punishment that has been described as demonstrating "the same sin, implacably condemned with one man, was considered only venial with one friend of the great lords."[11] Social status could be a determining factor in the outcome of heresy trials. In Paris, the Sorbonne and the Parlement of Paris destroyed 14 scientific theses and exiled the authors. Following the censorship, an astrologer and professor at the Royal College, Jean-Baptiste Morin, published a French translation of these works in the form of a retraction.[12] Morin was protected by highly-placed clerics and was a favorite of royalty due to the accuracy of his horoscopes.

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[6] Robert Mandrou, From Humanism to Science, 1480-1700, trans. Brian Pearce (Middlesex, UK: Penguin, 1978), 213-227.

[7] David T. Pottinger, The French Book Trade in the Ancien Regime: 1500-1791 (Cambridge, MA: Harvard University Press, 1958), 211. By 1543, the Sorbonne published a list of 65 prohibited books, all religious in content. Pottinger, 57.

[8] See Henri-Jean Martin, Livre, pouvoirs et societe a Paris au xvii siecle (1598-1701), 2 vols. (Geneva: Librairie Droz, 1969), 1: 56; Isambert, Jourdan, Decrusy, eds., Recueil général des anciennes lois françaises, 29 vols. repr. in 4 vols. (Paris, n.p., 1821-1833; repr., Ridgewood, NJ: Gregg, 1964-1966), 2 (13): 196.

[9] Robert Lenoble, Mersenne ou la naissance du mécanisme (1943, repr., Paris: J. Vrin, 1971), 178.

Strategies of Evasion

Despite efforts to protect the Aristotelian cosmology and the Scriptures, censorship did not achieve its intended goal. Inconsistencies in guidelines and rivalries among censoring agents led to sporadic and at times ineffectual control. Natural philosophers published abroad in

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[10] René Pintard, Le libertinage érudit dans la première moitié du xviiè siècle (Paris: Boivin, 1943; repr. Geneva: Slatkine, 1983), 185.

[11] Pintard, 34.

[12] MC 1: 167-168; MC 3: 175-176.

Protestant border states, relied on the protection of patrons, confined ideas to correspondence networks, or used rhetorical strategies to dissimulate views.

The Gallican Church, headed by the French king, retained some measure of independence from Rome. Although the pope had the power to issue a decree, he did not have the authority in France to insure its promulgation and enforcement. The Injunction of 1616[13] and the condemnation of the Copernican propositions (1633) were not promulgated in France and hence, not officially recognized. But the sentence against Galileo and the ambiguity of the Gallican Church did incline natural philosophers--many of whom were clerics--to comply with the decision of Rome. René Descartes wrote:

> I wanted to suppress entirely the treatise that I had done and lose almost all my work of the past four years to give entire obedience to the church as it prohibited the opinion of the movement of the earth.
> Yet, I have not seen that the pope or the council have ratified this prohibition by the Congregation of Cardinals. . . . I would be relieved to learn what is upheld in France and if . . . [the cardinals'] authority has been sufficient to make it an article of faith.[14]

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[13] The Injunction of 1616 rejected the two major premises of the Copernican system, that the sun is at the center of the world and that the earth moves, ruling that these propositions were "contradictory to the doctrine of the Holy Scriptures [and] erroneous in the faith." John L. Russell, "Catholic Astronomers and the Copernican System After the Condemnation of Galileo," Annals of Science 46 (1989): 366.

[14] Descartes to Mersenne, early Feb 1634, MC 4: 27.

Emigrés

Emigrés played a critical role in the dissemination of condemned texts, often serving as liaisons between France and Holland. René Descartes moved to Amsterdam to continue his work out of reach of censors. The Hellenic scholar Claude Saumaise was among the French Huguenots to settle in Leiden to escape religious persecution. Saumaise, instrumental in the publication of numerous manuscripts,[15] wrote from Leiden that should he return to France, "I would resolve to have, henceforth, neither voice nor pen that is free. It is one thing not to say or write what you would like. But to write or say what you do not want is intolerable."[16] A letter from Mersenne echoed this concern, "Never have we been more exacting than at present for the inspection of books, as Monsieur the Chancellor [Pierre Séguier][17] has qualified agents to determine what is theological [or] political."[18]

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[15] Guy Patin to Jacob Spon, n.d. 1643, quoted in Mandrou, 199.

[16] René Pintard, Le libertinage érudit dans la première moitié du xviiè siècle (Paris: Boivin, 1943; repr. Geneva: Slatkine, 1983), 98.

[17] As head of the book trade, the chancellor had the authority to appoint censors and issue the privilege.

[18] Mersenne to Descartes, 15 Feb 1637, MC 6: 186-187.

Correspondence Networks and Gatekeepers

Prior to the emergence of the first scientific journals (ca. 1666), correspondence played a significant role in the development and dissemination of early modern science.[19] Letters expedited the exchange of information and offered a means of evading censors.[20] Mail was not sent along direct routes but through individuals recognized as "nodal points"[21] or gatekeepers in the networks.

In the south of France, Peiresc was considered one of the major gatekeepers in the correspondence networks and instrumental in the dissemination of Galileo's initiatives. Peiresc's vast erudition, family wealth, and ties with influential circles brought him into contact with hundreds of individuals, through whom he exchanged services and information, or arranged for the publication of a condemned text.

Gatekeepers had the authority to transmit, adapt, or withhold information. Peiresc learned of Galileo's imprisonment[22] in July 1633 through letters the Jesuit

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[19] Mandrou, 195-196.

[20] Martin, 1: 220.

[21] Sarah S. Gibson, "Scientific Societies and Exchange: A Facet of the History of Scientific Communication," Journal of Library History 17 (1982): 148.

[22] Galileo was questioned by the Inquisition in April 1633 and was condemned on 22 June 1633 to abjure his beliefs and to remain under house arrest. Francisco Barberini did not sign the sentence.

Christopher Scheiner sent to be forwarded to two clerics--letters that Peiresc retained for several weeks.[23] The decision to withhold news of Galileo's sentence might be interpreted in different ways. Peiresc might have believed that the sentence of Galileo was an affair internal to the Roman Catholic Church. After all, the sentence and condemnation had not been promulgated in France.[24] Peiresc might have viewed this sentence as the result of Galileo's earlier misunderstandings with Jesuit astronomers, such as the dispute over the priority of the discovery of sunspots (1611-1612) or the nature of comets (1618-1623). Galileo later admitted that had he avoided these confrontations, he could have "written to his fulfillment on all subjects, even the movement of the earth."[25] Or perhaps Peiresc hoped to avoid a confrontation between religion and science, stressing that "so many other affairs of great consequence would have amounted to little if one had not proceeded with such vehemence."[26]

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[23] Armand Beaulieu, "Les réactions des savants français au début du xviie siècle devant l'héliocentrisme de Galilée," Convegno internazionale de studi galileian (Firenze: Giunti Barbera, 1984), 374.

[24] MC 3: 452.

[25] Galileo to Diodati, 25 July 1634, Guglielmo Libri-Carucci, "Life of Galileo . . . Vie de Galilée," Journal des savants (April 1841): 213.

[26] Peiresc to the Brothers Dupuy, 6 Feb 1634, PL 3: 28.

A Protestant magistrate in Paris, Elie Diodati, played an important role in the communication of censured texts. A social gadfly and Galileo's confidante, Diodati has been described as "ready to please his friends or the interest of science, to use trickery with the Index [of Prohibited Books] or to tackle the Inquisition."[27] Under the pseudonym of David Lotaeus, he arranged for Latin translations of Galileo's Dialogue of Two Chief World Systems along with a condemned treatise (Lettera, 1615) by a Carmelite priest[28] to be published by Mathieu Bernegger in Strasbourg, Germany, in 1635.[29] Copies of the translation were shipped to Paris.[30] On 10 July 1635, Peiresc wrote the Brothers Dupuy,

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[27] Pintard, 131.

[28] See Peiresc to Diodati, 7 Feb 1634, MC 4: 32-33; MC 5: 272-273; The priest Antonio Foscarini's work was condemned following the Injunction of 1616 which prohibited discussion of the Copernican propositions as a real system. The publication On Revolutions by Copernicus was suspended pending corrections to be made in the text--changes that would present the system as hypothetical. By 1617, Foscarini was dead and his publisher, Lazaro Scoriggio, imprisoned in Italy. At that same time, the Dutch publishing company of Willem Blaeu issued a third edition of Copernicus's book. Elizabeth L. Eisenstein, The Printing Press as an Agent of Change: Communications and Cultural Transformations in Early-Modern Europe (Cambridge: Cambridge University Press, 1979), 676.

[29] The Dutch publishing house of the family Elsevier in Leiden financed this edition in Strasbourg. MC 5: 82.

[30] Mersenne informed Peiresc on 1 July 1635 that he had received one of 350 Latin versions that arrived in Paris.Mersenne to Peiresc, 1 July 1635, PC 2: 550.

> I will be pleased to have a copy of the Latin Version of Galileo . . . and will be careful not to send it to Italy or publish it until I am certain that there is nothing more to hope for his [Galileo's] relief from Rome . . . if the book of Galileo's can be sent by the ordinary post in two or three packets, there will not be a great danger to run.[31]

While privately circulating works condemned by Rome,[32] Peiresc also maintained epistolary exchanges with Roman clerics. He appealed to Cardinal Barberini for a mitigated sentence for Galileo and solicited the help of missionary priests in the organization of astronomical observation stations for his work in longitude. Peiresc's official position and status provided a façade enabling him to disseminate information out of reach of censors.

Patrons

Patronage positions, personal connections, and social status offered some protection from political and clerical control.[33] In a letter of 5 August 1574, the Italian humanist Giovanni Vincenzo Pinelli requested books be shipped through Venice as there he had the "`father inquisitor who is my friend. And he will give me immediately everything that is not truly pernicious in its total substance, which might not be the case with other inquisitors.'"[34] Other patrons arranged for special permission to read censored books as Peiresc explained to a correspondent: "You can provide yourself in advance with a special permission and license from the Father Maestro of the Holy Palace, or from the Grand Penitentiary."[35] On other occasions, Peiresc sent packages to Rome in care of highly-placed church officials. "If the address is not to Mr. the Cardinal [Francisco Barberini]," he explained, "customs will treat it poorly and possibly the inquisitors worse, given that all books pass by their hands if the respect for the Padroni does not stop them."[36]

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[31] Peiresc to the Brothers Dupuy, 10 July 1635, PL 344-345.

[32] Peiresc to Hortensius, 24 Jan 1634, MC 4: 10; MC 4: 164.

[33] Peiresc to Holstenius, 14 March 1631, PL 5: 364.

Patronage provided a means of self-advancement and financial support.[37] It also offered protection from censors. The Jesuit Christopher Scheiner's letters on the sunspots were addressed to the powerful German patron Marc Welser and published under the pseudonym "Apelles."[38] Galileo's book of observations of the satellites of Jupiter was dedicated to the Cosimo II de Medici. The Medici patronage and ties with the Accademia dei Lincei enabled Galileo to improve his social status and to obtain protection from censors. His later problems with the Inquisition can be in part attributed to changing patronage relationships.[39] Belisario Vinta, who arranged the patronage position with the Medici died in 1613, and Cosimo II de Medici, in 1621.[40] The death of Prince Federico Cesi in 1630 led to the decline of the power of the Accademia dei Lincei in Roman affairs.[41]

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[34] Quoted in Paul F. Grendler, "Printing and Censorship," The Cambridge History of Renaissance Philosophy, ed. Charles B. Schmitt (Cambridge: Cambridge University Press, 1988), 53.

[35] Peiresc to Holstensius, 8 June 1629, PL 5: 336.

[36] Peiresc to Holstenius, 8 June 1629, PL 5: 336.

[37] Mario Biagioli, "Galileo's System of Patronage," History of Science 28 (1990): 3, 12-13.

[38] William R. Shea, "Galileo, Scheiner, and the Interpretation of Sunspots," Isis 61 (1970): 489-501.

Rhetorical Strategies

Rhetorical strategies enabled some natural philosophers to safely publish their views. Libertine Gabriel Naudé used pseudonyms, fictitious publishers,[42] and abstruse language, or he relied on a powerful patron (e.g., Cardinal Barberini) for protection from "discerning censors."[43] In the ad lectorum of Copernicus's book, On Revolutions (1543), the printer Andreas Osiander stated that the hypotheses were not true but provided a means of explaining phenomena. The journalist Théophraste Renaudot printed a lengthy retraction in his newspaper on

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[39] Biagioli, 15-17.

[40] Biagioli, 15-16.

[41] Biagioli, 17.

[42] Martin, 1: 179.

[43] Pintard, 465.

5 January 1634 for a public conference on the Copernican system, a means of calling attention to the heliocentric theory.[44]

The use of interlocutors provided a persuasive means of advancing unorthodox views under the guise of a debate.[45] Galileo's dialogue among a Copernican, a layman, and an Aristotelian provided harsh criticism of the Aristotelian world-view and presented a theory of the tides as proof of the earth's movement.[46] Yet the dialogue was prefaced by a disclaimer, in which Galileo stressed that his purpose was to demonstrate that Italians were knowledgeable of the Copernican propositions.[47] Renaudot published his conference proceedings in the form of a dialogue and used logical reasoning to attack the university Scholastics or Aristotelians themselves. The spokesman for the Aristotelian position stated that:[48]

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[44] Renaudot, Relations, 5 Jan 1634: 530-532.

[45] Steven Shapin, "Pump and Circumstance: Robert Boyle's Literary Technology," Social Studies of Science 14 (1984): 503.

[46] Galileo Galilei, Dialogue Concerning the Two Chief World Systems, trans. Stillman Drake (Berkeley: University of California Press, 1967), 5.

[47] Galilei, 5.

[48] Traditional support for an immobile earth included: projectiles and cannon balls fall vertically; both cities and the surface of the earth could not withstand motion; the heat of the air caused by movement would suffocate all life on earth; and the Scriptures held otherwise. Eusèbe Renaudot, ed., Conference 10, "Of the Motion, or Rest of the Earth," Another Collection of Philosophical Conferences of the French Virtuosi, trans. G. Havers and J. Davies

> Decorum and symmetry of the universe require that everything be placed according to its dignity. But the earth, being the most ignoble and base of the elements, which yield to the dignity to the Heavens, should be consequently in the lowest place, the center of the world.[49]

Using the same rhetorical format, the Copernican spokesman brought in theological arguments to support his position:

> The center, being the most noble place, is therefore the proper place for the most noble body of the world, the sun. As the heart is located in the midst of man, so it is that the sun be placed in the midst of the universe. . . .Nor do we place the candle in a corner but in the middle of the room.

The priest Marin Mersenne's Theological, Physical, Moral and Mathematical Questions[50] presented a series of questions on diverse subjects: navigation, occult properties, popular beliefs, and natural philosophy. Each question was followed by premises from which inferences could be made. For example, in Question 34 Mersenne described the Copernican system as offering simplicity and economy of motion. But he added that God did not necessarily select the most efficient movement in the world. Rather, experience seemed to indicate an immobile

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(London: printed for Thomas Dring and John Starkey, 1665), 58-59.

[49] Eusèbe Renaudot, Conference 10, 58-59.

[50] Marin Mersenne, Les questions theologiques, physiques, morales, et mathématiques où chacun trouvera du contentement ou de l'exercice (Paris: Henry Guenon, 1634).

earth.[51] Many of these explanations were motivated by the desire to keep God in the scheme of things and to avoid being charged with putting limitations on the concept of an all-powerful God.

Although Mersenne's book carried a permit and privilege, the censors found that it did not adequately refute the mobility of the earth.[52] Faced with possible censure, Mersenne modified passages in his text so as to be "more appropriate for Rome."[53] Question 34, "What reasons are there to prove and persuade that the earth moves around its axis in 24 hours?" was substituted with "Can we invent a new science of sound?" Question 37 originally read, "What reasons can we have to believe the earth moves around the sun, which is at the center of the world?" The meaning changed in the revision: "How high above the earth or sun do we need to go to see as much space as desired?" In the place of a discussion of Galileo's attack on the Aristotelian world-view, Mersenne wrote, "What force is needed to carry a voice from earth to the firmament?"[54]

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[51] Mersenne supported this statement by analogy rather than evidence. "Would it not be simpler," he wrote, "in healing the body to have a hole in the heel where all the superfluous humors should leave, hence avoiding so much medicine?" Mersenne, Questions, 165.

[52] Mersenne to Peiresc, 28 July 1634, MC 4: 267-268.

[53] Mersenne to Peiresc, 28 July 1634, MC 4: 267-268.

[54] See MC 4: 75, 270-271.

The text also included summaries of the first and second days of Galileo's Dialogue but avoided mention of Day 4 of the Dialogue, in which Galileo claimed that his theory of the tides provided proof of a mobile earth. One version of Mersenne's book circulated in France and another in Italy. Both texts included a copy of Galileo's sentence, a tactic Mersenne used to imply recognition of church authority.[55]

Conclusion

While the legitimacy of the church was gounded in its role as arbiter of God's word, it did not have the authority to secure compliance for its decrees. In contrast, the power of the gatekeeper was not obvious but it was pervasive. Gatekeepers served as interfaces between the private academies, the correspondence networks, and institutions of the church and crown. Often their social status provided legitimacy needed to control the exchange of information. Gatekeepers manipulated readers through the inclusion and exclusion of information. They dealt on multi-levels with a diversity of individuals while maintaining the semblance of compliance to traditional authorities.

While the church and crown tended to deny the legitimacy of the new science, the correspondence networks provided the forum for discussion of new ideas.

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[55] Mersenne to Peiresc, 28 July 1634, MC 4: 267.

Gatekeepers and patrons legitimized activities through social status and personal prestige. Furthermore, natural philosophers devised numerous strategies to secure the free exchange of scientific information in a period of oppression. Letters provided an efficient means of expediting the dissemination of ideas generally out of reach of the censors. Rhetorical strategies offered effective means of communicating news of scientific activities. While Galileo relied on persuasive claims and telescopic evidence to support his views, Renaudot and Mersenne included analogy, familiar examples, and experiential statements. These strategies also enabled the control of information exchange and hence affected public knowledge.

Words and Pictures: Expert and Lay Rationality in Television News

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Presented to:
Science Writing Educators Group
AEJMC
Montreal
August, 1992

Abstract

This content analysis of network television news coverage of the greenhouse effect for 1989 and 1990 documents how television reflects two distinct views of risk. The words of television reports, as analyzed through sourcing patterns and news pegs, reflect the current thinking of the U.S. political elite and, to a lesser extent, the international scientific community. The approach to the problem reflects what some scholars refer to as "expert rationality" about risk. Television's videography, however, provides a different portrait. Pervasive visual images included polluted air and images of a pristine environment. These images were at some variance with the words of television news and may reflect what scholars refer to as a lay risk heuristic. Taken together, televisions words and pictures may provide an example of how the medium "equalizes" perspectives on risk.

Introduction: The "Pictures In Our Heads" About Risk

Different groups of human beings maintain dichotomous views about risk. One is the domain of the expert, the other the domain of the average person. (Fischhott et. al. 1982). Both have important qualities to contribute to understanding risk--particularly when risk is tied to public policy issues.

Expert rationality is characterized by a mathematical understanding of risk. For example, experts consider the possibility of a base rate accident when evaluating a risky system or situation.

Base rates are the mathematical expression of the likelihood of any system breaking down. For example, the probability of an American being involved in a serious auto accident during his or her lifetime is one in three, regardless of highway or automobile design. One in three is the base rate, and there is nothing that better engineering can do to alter it. Base rates also are applied to diseases such as cancer. The assumption again is that in any normal population, some cancers will occur.

Expert rationality is the foundation of risk assessment and is consequently based on the mathematical probability of a specific occurrence within known parameters. Expert rationality seldom assumes a risk-free environment but rather attempts to weigh the likelihood of certain sorts of accidents or risks against the expense and inconvenience of preventing them. Scientists, engineers, mathematicians and those familiar with certain sorts of risky systems tend to evaluate risk in this way (Slovic et al, 1980). Expert rationality leads to judgments about risk that are framed primarily in terms of mathematics and probabilities, and which assume--sometimes erroneously as in the case of Chernobyl or Bhopal--that highly engineered systems will perform in predictable ways. Scholars have recently begun to criticize this form of risk assessment on the grounds that engineered systems can behave in unpredictable ways, particularly when human beings interact with them (Perrow, 1984; Pidgeon, 1988).

But, the average person evaluates differently, through a heuristic known as lay rationality. While expert rationality links risk with mathematical concepts and engineered systems in which people are often either a tangential or a not well understood component, lay rationality tends to place the responsibility for risk with the individual in a causal and ethical sense.

Lay rationality does not evaluate risk in strictly mathematical terms. In fact, research has documented that most people do not consider the possibility of a base rate accident when evaluating potential risks. (Gregory 1991). The average person's risk heuristic includes fairness (will it hurt me as much as my neighbor?), control (risks over which people have some control are viewed as less likely than those that seem controlled by others, statistical evidence to the contrary, and dread (will I be greatly harmed by this risk?). Other research has added the notion of "loss" to the lay heuristic (people are more likely to believe something is risky if they lose something they already have rather than merely "losing" an opportunity to acquire something) (McClelland & Schulte, 1986).

Studies also have found that lay rationality is linked with exposure to news. Risks that receive a great deal of news coverage (being struck by lightning or a nuclear power accident) are rated as more likely to occur than risks that receive less coverage (routine auto accidents). (Slovic, 1985)

Given these findings television becomes an important medium for scholars to understand. Beginning in 1964, more and more Americans began to get their news from television (Roper 1987). What those news accounts include has been at least partially documented. Television news accounts of science and risk reflect the same biases as print reports, (Gans 1979; Nelkin, 1987), including framing events through widely held cultural values (Gans 1979). Television reports may also exaggerate some tendencies of print, particularly when it comes to framing news in terms of events (Wilkins 1987; Patterson 1989), producing images that focus on victims (Wilkins 1987), and retelling events in terms of predictable scripts, including the script of discovery (Franklin 1986; Nimmo and Combs 1986, Patterson 1989).

People do learn from television news (Lowery & DeFleur 1983). 983). However, what people learn is contested ground. When people are questioned about facts, some studies indicate that people retain more factual content from print reports than they do from televised accounts (see for example Patterson 1980; Wilkins 1987). Other studies dispute this assertion (Drew, 1991). But, scholars agree television viewing still does lead to some factual learning, and may spur some viewers to read more about specific events. Even young children learn a great deal about science from the tube Hamm (1991).

Television helps set the public agenda, including the agenda for politics and science (McCombs & Shaw 1972). Indeed, television does more than help set the agenda--it primes the audience to believe that certain issues are more significant than others (Iyengar and Kinder 1987). Television has become the way the public seeks to learn first about events such as the 1989 Loma Prieta earthquake (Newhagen and

Lewenstein, 1991). And, at least one scholarly study has found that television, with its focus on immediacy, helps frame the event not just for the audience but for print journalists who have almost invariably viewed television accounts of disasters before they arrive on the scene to begin their own reporting (Smith, forthcoming 1992).

This last finding--that television helps frame the event for print reporters--is particularly significant because part of that framing apparently occurs through the use of visual imagery. If television helps other journalists "see" a story in a particular way, then the medium has become influential on a subtle but important dimension.

Television's focus on the specific and the vivid coupled with traditional definitions of news may interact on another level. Journalists often focus news accounts on specific people or occurrences. Systemic analysis, if it is included at all, seldom constitutes the bulk of these reports. Psychologists term this tendency to attribute problems to individuals rather than systems fundamental attribution error. This particular bias has been linked to news accounts (Stocking and Gross, 1989; Wilkins and Patterson 1987), even though journalists often quote scientists providing a much more systematic analysis.

The media's ability to reflect both views of risk allows it to play an important role in symbol formation.

> We have found that the media tend to dramatize but do not re-construct a risk communication. They highlight the existing uncertainties, dissonances, and conflicts. **The media are a great equalizer of perspective on risk**...The media does play an important role in fixing images...that determine how risk information will be processed (Krimsky and Plough 1988:302).

If scholars who have studied both the mass media and risk perception are correct, then television would seem to be one medium where various perspectives on risk could be "equalized". Furthermore, it would be important to discover how television's pictures and words contribute to this leveling of perspectives.

The Method

This study is a qualitative analysis (with quantitative work where appropriate) of coverage of the greenhouse effect on the national network news from 1989-1990.

Stories using the key phrases "greenhouse effect", "global warming" and "global climate change" were obtained from the Vanderbilt Television University archives. In the two-year period, a total of 63 television news stories were found that used the three phrases at least once in the copy. Two of these stories were culled, one a sports story and a second on gardening, leaving a total of 61 stories to analyze. The story served as the individual unit of analysis, although some of the analysis required that specific words or visual images be noted in individual news accounts.

Scripts of the stories were transcribed using an audio tape. The scripts were then compared to the video tape for corrections. Two coders pre-tested a coding instrument and then coded the stories. Differences in interpretation were evaluated and an overall inter-coder reliability rating of 95 percent was achieved.

Coding categories for the verbal portions of the broadcasts included the network on which the story aired, the month and year the story was produced, whether the stories were news, feature or opinion, the number and type of source cited, the news peg, the amount of coverage devoted to the greenhouse in each story, whether the story discussed the future, and how politics was treated in each piece.

The visual portions of the story were categorized as follows: the number and types (for example animated as opposed to line drawing) of graphics used, the sources pictured on screen, the visual imagery common among the various news reports, (for example factory smokestacks or trees) and the length of each piece. No attempt was made to "count" production values such as individual edits. However, the visual impact of the piece was analyzed in a more holistic fashion--if a story included "something" that was visually unusual, it was noted.

It is important to note that finding these 61 broadcast news accounts was not a matter of looking up key words in an index. Vanderbilt does not index stories using the key words "greenhouse effect" or "global warming". Rather the stories were obtained by gathering all stories indexed under such headings as environment, weather, and pollution plus checking specific events such as the Yellowstone forest fires and cross checking those stories against the credit lines of the network science correspondents. More than 12 hours of network television coverage was viewed to obtain the data base. While initially this seemed like an enormous amount of work for little gain, viewing more of the totality of network coverage raised some important issues, particularly with regard to visual imagery, that will be considered in the conclusions.

There is one important methodological caveat. This study is part of a larger study of media coverage of the greenhouse effect. And, like most research, there is some serendipity involved. In the original research design, it was not anticipated that television's visual images and verbal content would reflect the sort of subtleties described in this paper. There is nothing in the existing scholarly literature to hint at such a specific distinction. Consequently the original coding categories were not designed to specifically examine lay as opposed to expert versions of rationality about

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risk. It was only after the coding was complete and the results unexpected that it was possible to return to the scholarly literature and attempt to make some theoretical sense of these findings. Such are the continual imperfections of all research designs, particularly in the "emerging" field of risk communication.

The Coverage: An Overview

Like many other science-related stories, for example AIDS (see Rogers and Chang 1991), television coverage of the greenhouse effect has had a pattern in time. Television reports about the issues were relatively infrequent when the study began: only one story was found in 1987 and only 10 in 1988. (A preliminary analysis of the 1987-88 television greenhouse coverage may be found in Wilkins and Patterson, 1991.) However, in 1989, a total of 24 stories appeared, in 1990 there were 34 television news accounts that at least mentioned the problem. All the 1989-90 stories were relatively evenly distributed among the three television networks: ABC aired 24 (or 39 percent of the stories); CBS 22 (or 36 percent), and NBC 15 (or 25 percent). It also should be noted that during the study, ABC and CBS changed science correspondents leaving both networks without a full-time science reporter for several months.

This pattern of a slowly developing story with more coverage every year also reflects coverage patterns in the print media (Wilkins 1991).

Television, just like print, paid more attention to the greenhouse when the weather got warmer. More than half of the television coverage was aired during the months of April through August and the remainder of the coverage was more scattered throughout the year. There was some coverage in the colder months--

primarily in year-end wrap-ups and new year analysis that appeared on all three networks.

Almost two-thirds of the television stories were event-oriented; only 25 percent of the stories were feature reports and even fewer--13 percent--were considered analysis. Sixty percent of the television accounts were hard news. About 46 percent of the stories mentioned the greenhouse effect in the lead and an additional 13 percent mentioned the term in the top fourth of the story. In other news accounts, although the term might have been mentioned, the focus on the greenhouse was secondary to other events or issues.

Regardless of the placement of the greenhouse issues within a story, fully half of the stories studied focused on politics, primarily appearances before Congressional committees or international bodies such as the United Nations or negotiators at the Montreal Accords. In fact, the single largest spurt of television coverage occurred in May of 1989 when Dr. James Hansen of NASA appeared before a Congressional Committee and testified that he was "99 percent certain" that the drought of 1988 was due to the greenhouse effect and that the White House Office of Management and Budget had ordered him to soften his Congressional testimony. The television accounts of Hansen's appearance focused almost exclusively on the politics of the White House's unsuccessful attempt to alter Hansen's statement. There was relatively little discussion of the scientific findings about the greenhouse effect in those stories.

After politics, the science of the greenhouse itself was the news peg for 18 percent of the stories, and an additional 10 percent focused on a "new finding" in science. Many of those stories, however, did not deal directly with the greenhouse effect but rather with the most recent findings of space exploration or the studies of the ozone hole. The greenhouse issue, when mentioned in these reports, often was not the primary focus. An additional 16 percent of the stories focused on the politics surrounding the greenhouse issue. Many of these stories dealt with various international agencies or agreements that were being negotiated and/or signed during the study period or with Los Angeles' air pollution control initiative.

The sourcing patterns for the stories also reflected some of these core tendencies.

Despite its scientific components, television coverage of the greenhouse issue tended not to focus on the scientific community. In all the stories examined, 73 percent did not "source" the story through the scientific community or literature. About 27 percent of the stories cited at least one scientist. Scientists were the dominant sources in stories that focused on scientific discoveries or reports. Other stories involved scientific sources much less often--and sometimes scientists were used as sources in discussions about politics rather than the pure science of the issue. Hansen's Congressional testimony is the outstanding example of a scientist playing this dual role in television coverage.

And, in a debate framed largely as a political issue, it is not surprising that politicians--both national and international--functioned as the dominate sources for greenhouse stories. Fewer than half--46 percent--of the stories did not include a political source. About 23 percent of the stories cited at least one political figure; an additional 23 percent cited two or more. There were a small number of stories in which specific sources were not mentioned.

It is important to note, however, that television did not treat all political sources equally. Television coverage of the story--at least in its sourcing patterns--seemed to reflect national political policy on the issue. (The fact that coverage reflects national policy has been a consistent finding on analysis of international news coverage (Cohen, 1963).)

The Bush administration has adopted a generalized "we need more study" approach to the problem while environmental groups and some members of the scientific community, particularly Hansen and Dr. Steven Schneider, have called for political policy development on the question. Environmental Protection Agency Administrator William Reilly has sided with the environmentalists and scientists on the issue--amid at least some reports of friction with the White House, particularly while Chief of Staff John Sununu held that post.

Sourcing patterns in television news reflect the White House view of the greenhouse. Reilly was cited in 12 percent of the stories--often as a middle ground or "other side" source for the political implications of the greenhouse. However, Bush and other White House aids, including Sununu, were cited in 41 percent of the stories. Clearly, the official, White House view of the greenhouse problem was given more air time--at least in terms of sources cited--than other approaches.

More than half of the stories, 51 percent, did not include verbal mention of specific "harms" resulting from the greenhouse effect. Other stories did mention "harms" such as rising sea levels, possible changes in climate, rising temperatures, etc. As has been noted in the other research (Wilkins and Patterson 1991), the term greenhouse effect does not seem to be a neutral one in news reports. Rather, use of the term itself seems to imply something bad or potentially harmful.

However, the words of television news provide only one component of meaning for television news accounts. The pictures also were informative, both in terms of who and what was pictured, but also in a more global sense of what those pictures may have conveyed.

The Visual Greenhouse

It has not been lost on the scientific community that the phrase greenhouse effect is a visual metaphor. Most lay people probably think of a botanical greenhouse when they hear the term rather than the more scientific meaning for the phrase: the set of the physical, atmospheric conditions that warm the planet. In fact, Schneider has said that the greenhouse phrase, with its connotations of warmth, life and general pleasantness, is a poor one for a problem that may ultimately make life much more unpleasant. Perhaps the term hot house would serve better for this purpose. This inability to locate the problem with precise yet evocative language may have accounted for one change noted during the course of the study: the phrase greenhouse effect was used much more early in the coverage only to be supplanted by the phrases "global warming" and "global climate change" during 1989 and 1990. Whether these more neutral terms mean different things to the average television viewer would be an intriguing area for study, but one that is outside the scope of the current research.

Television's pictures reflected much the same problem. On one hand, in order to explain the greenhouse, television had to provide an explanation that involved some science of the issue. But, on another level, the pictures themselves reflected the problems a visual medium has in dealing with something that is inherently only as visible as the air and which remains both scientifically and politically contentious.

Television generally opted for introducing the topic of the greenhouse effect through topical graphics that functioned more or less as the equivalent of logs or headlines and explaining the science of the problem with more traditional graphics.

A total of 51 topical graphics were used in about 75 percent of the television stories. Two of the most prominent were essentially what print journalists would call running headlines: "American Agenda" on ABC and "Assignment Earth" on NBC. Others included the words greenhouse effect with a picture of the earth with a halo around it. A variation on the same graphic was used nine times with the words "global warming" substituting for "greenhouse effect". Two of the more remarkable aired only once: one with the words global warming superimposed over a thermometer and another with the words "greenhouse effect" next to a graphic of the earth going through an hourglass representing time running out.

Explanatory graphics were used much less frequently, in only about 21 percent of the stories, in part because science did not dominate many news accounts. The explanatory graphics varied widely. Several illustrated atmospheric chemistry with pictures of the earth, the sun, an atmospheric halo, and arrows indicating escaping and trapped heat. One graphic included a thermometer and several included atmospheric colors changing to red to indicate heating.

Perhaps the most intriguing were the still photographs used as illustrations in a small percentage of the stories. These showed grain riots in Africa, the hot sun, howling wind and stock exchange fights. However, the illustrations were "posterized" versions of potential events, not news footage.

Moving footage was used primarily in four ways. The most dominant was the interview, often of political figures or scientists, talking about various issues primarily the signing of international agreements. The second was footage that was used to illustrate the effects of the greenhouse, while the third most frequent use showed possible causes of the problem. The fourth use was to show people "doing something" about the problem--although in some cases doing something amounted to giving a speech or planting a tree.

About 56 percent of the stories relied on moving footage to illustrate an effect of the greenhouse and many stories used more than one such illustration. The visual contrast with the words of television accounts which mentioned specific harms less frequently. It was one instance where the medium's words and pictures were at some variance.

Most of that moving footage focused on the earth itself, often in the absence of people. Sample footage included the following: dry, parched fields, destroyed agriculture, empty rain gauge--about 13 percent of those stories ran such video; hot sun, warm temperatures--about 10 percent; rising seas, eroding coast lines--about 10 percent; loss of forest or damaged forests--8 percent; smoggy skies--about 8 percent; melting ice--about 11 percent; destroyed wildlife, polluted streams, oil spills, mountains or tundra--about 17 percent; pollution, satellite pictures of pollution, smoke--about 15 percent; and people in poverty--about 1 percent. It is important to note that many of these images were bereft of people.

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Additional footage was used to illustrate potential causes of the greenhouse problem. About 60 percent of the stories used such images, including: some form of automobile transportation--about 22 percent of those stories that used such an image; factories spewing out smoke--about 19 percent; barbecues, lawn mowers, spray paint, aerosol cans, etc.--about 16 percent; oil drilling, derricks, coal mines, tanker ships--about 12 percent; burning or destroying American forests--about 8 percent; foreign sawmills--about 6 percent; and foreign busses, cars, freeways, etc.--about 1 percent. In contrast to the images of the greenhouse effect, the images of the causes included people--if the researcher is willing to accept that a picture of a car tailpipe assumes a human driver.

While television's news accounts were peppered with images of the results of and possible causes of the greenhouse effect, there was much less moving footage devoted to responses to the problem. About 65 percent of the stories did not include images that suggested responses, although in a few cases the text that accompanied these same pictures did. Of those responses to greenhouse problems that were shown as moving images, the following were the most common: recycling--about 18 percent of those stories that used such an image; planting trees--about 15 percent; exploring space--about 12 percent; Earth Day (both 1970 and 1990)--about 12 percent; proposed/passed legislation--about 12 percent; forms of scientific research--about 9 percent; protests and demonstrations--about 6 percent; ecological farming (without heavy use of pesticides and fertilizers)--about 3 percent; and cleaning up trash--about 3 percent. Again it is important to note that few of these images center on political activity and that many others rely on technology to "fix" the problem.

Television's demand for the visual also created at least one ethical problem for videographers and editors. Since the greenhouse effect is essentially an invisible event, television journalists had to find visual representation. The demand for new footage was constant, and occasionally the networks took some shortcuts. Specific footage was repeated in at least eight instances, four of which were noted--for example with the words "file footage"--within news accounts. But, at least, four other instances of repeat footage went unacknowledged. In addition, there were numerous shortcuts of footage of factory smokestacks and auto exhaust. At least some of these images were recycled from news account to news account as well.

By far the most common moving visual image was connected with the interview, and that image was ethically problematic as well.

There were no people of color and very few women interviewed on camera in television news accounts of the greenhouse effect. People of color appeared only twice in the background of some footage, once at a private environmental conference and the second at a steel mill.

With that imbalance noted, television pictures reflected the medium's words--at least in terms of sourcing patterns. University scientists were pictured 22 times, government officials or scientists working for government agencies were pictured 40 times, environmentalists, private citizens, and movie stars acting as environmental spokespersons or advocates, 41 times, and business or community leaders, 4 times. As has been noted in other studies (see for example Wilkins 1987), television tends to source environmental stories more heavily using "private citizens" than does the print media. It is also difficult to disentangle whether scientists working for government agencies are acting at the behest of the agency or whether, as in Hansen's case, they are acting in opposition to it and functioning first as a scientist rather than as a governmental spokesperson.

Pictures can mean many different things to people. But this review of the content of television's visual and verbal messages about the greenhouse effect indicates that television coverage of the issue may be presenting some complicated information about one environmental risk in some unintended ways. What those messages are may have an important impact on understanding how the average person may interpret much of what he or she sees and hears emanating from the television set.

Visualizing Two Rationalities

When television's words are compared to its pictures, one significant trend seems to emerge. The words and pictures of television news do not consistently reflect either expert or lay views of rationality.

A number of findings support this generalization. First, the dominant sources cited or shown on screen were scientists or public officials who are responding to comments from scientists. The content of Bush administration interviews is particularly noteworthy for, with the exception of Reilly, administration figures, including the President, were quoted as seeking more study rather than discussing potential policy questions. Seeking more scientific study was an accurate reflection of the administration agenda and/or at least some experts. A discussion of political alternatives, on the other hand, would have entailed some discussion of issues such as resource distribution. Because most television news stories were event-centered, there was little air time for discussion of political alternatives to the various scientific and business experts cited.

Some of television's images, particularly the bulk of the introductory and explanatory graphics, also supported this "expert" approach. With their focus on the science of climate, or their use as televised running heads, their visual information was tied closely to the verbal, and expert dominated, information in television news reports.

The outstanding exception to this trend was the number of citizen/activists who were interviewed for greenhouse reports, many of whom wound up on camera. These were people who were, by in large, raising the sort of fairness and value questions associated with lay rationality and which many members of both the scientific and political community acknowledge are an important part of the political debate over the greenhouse (Schneider 1989). A minority of scientists also raised these questions.

But, television's pictures provided a deeper and more pervasive focus on lay rationality. Two images pervaded almost all the greenhouse coverage--both in the form of moving footage. The first was of polluted air, usually visualized through shots of factory smokestacks or motor vehicle tailpipes and exhaust. Such shots appeared in many stories, often more than once. Their cumulative message is one of undifferentiated pollution. Repetition of such images would give a sense of pollution that is out of control and pervasive, two elements of a "lay" view of risk. Since industrial pollution is a human product, these images also reinforced a personal as opposed to systemic view of pollution.

The second repeated visual image was one of a pristine environment--mountain streams, unspoiled landscapes, or alternately, close-up shots of obviously healthy plants. These images, too, were numerous and helped to complete the visual image of the greenhouse metaphor. The videographers and editors who shot the footage--at least if the words that accompany the pictures are some indication--intended the shots to represent potential losses the greenhouse effect might produce. Whether viewers made the close connection between the words and pictures is a more open question, and it is clearly possible for the images to be interpreted or remembered in more than one way.

Trees provide an outstanding example of an image with this potential dual role. In the initial cull of stories, it was impossible not to notice the number of news accounts that involved images of trees but did not use any of the three key-word phrases regarding the greenhouse effect. Some of these accounts, for example an investigative piece about the harvesting of federal forest land in Alaska, clearly intended the tree to be a specific visual hook for a particular news peg. But, in other stories the visual role of the tree was much less clear and was linked to coverage of generalized environmental pollution which did not include such specific verbal cues.

Interpreting these images of trees was problematic, particularly since television presented planting trees as one response to the greenhouse problem. In literature, green, growing things represent life. In the greenhouse effect, green growing things were used as a visual representation of a problem as well as a response to it. One way a viewer would know what is intended by linking words with images. However, the words and images were inconsistent.

But, as scholars know, symbols can take on a life of their own. The dominance of the visual image of the tree in stories about pollution may be one indication of such symbolic power. Clearly, growing trees represent something humanity would not like to lose. Whether viewers are able to link this potential loss with a specific problem, such as the greenhouse effect, without a verbal cue, is debatable. Preliminary research suggests that viewers may respond to desperate words and visuals by becoming unwilling to make inferences about the policy issues framed in news reports (Wicks and Drew, 1991).

What is more supported by research evidence is that such images are characteristics of lay rationality. Frequently occurring images on the television screen, uncontrolled pollution from factory smokestacks, parched farm land, eroding beaches, also supported a lay view of the problem. This televised lay rationality was not unadulterated; there was much evidence of an expert view of the problem included in visual images.

Television's coverage may have provided viewers with a view of risk that was unintended by reporters or their sources. The fact that at least two layers of mediated messages about risk may help explain why the public does not always accept the problem as defined through the expert pint of view.

These two levels of meaning tucked within a single television account may help explain how the media function as an equalizer of perspectives on risk. Television's pictures may help the average person bring values and ethics back into a discussion of environmental risk, even though such an approach is not sustained by the words of the experts who are also pictured on the small screen. In this sense, the visual images are functioning in a truly symbolic fashion, one that places the expert on the same ground as the citizen. For an issue like the greenhouse effect, where the science is contentious and the choices grounded in ethics and politics, such a quality of risk communication is perhaps unexpected., but may have much to recommend it.

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NEWS FROM THE RAIN FOREST:
THE SOCIAL INTEGRATION OF ENVIRONMENTAL JOURNALISM

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NEWS FROM THE RAIN FOREST:
THE SOCIAL INTEGRATION OF ENVIRONMENTAL JOURNALISM

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The destruction of the Amazon rain forest is an issue defined primarily through the accounts of environmental journalists who find themselves caught between broad social and cultural forces. This paper traces the significance of the Amazon rain forest in terms of the thought of social theorist Niklas Luhmann, who describes ecological problems in terms of social differentiation and integration. Three separate domains of environmental discourse about the Amazon rain forest are identified in mass media: scientific, economic and political. Science defined the rain forest first in terms of its taxonomy, then its biodiversity; in economics, the forest is a natural resource; and for the political sphere, the forest is defined variously in terms of the struggle over control of its exploitation. Each domain of journalistic discourse is traced. Finally, interest is cited in a fourth domain of environmental discourse--the religious or spiritual--in terms of its ideological implications for the practice of environmental journalism and the rain forest as social topic.

NEWS FROM THE RAIN FOREST:
THE SOCIAL INTEGRATION OF ENVIRONMENTAL DISCOURSE

The answer to the question...of ecological communication...must ...be a change in the formulation of the problem. (Luhmann, 1988: 134).

A deep ecologist, observing environmental journalists at work, described newspeople as "rapt and articulate students of the mythical images swirling about them" (Nollman, 1990: 136). Not only were the newspeople reporting on environmental issues, they were involved in the creation of those issues, shaping their appeal to a level of extrarational understanding only vaguely articulated by the facts used to legitimate the reports.

In the broadest sense, journalists are protagonists who are at the center of societal evolution toward an emerging post-materialist perspective about nature and the human environment (Young, 1990). What journalists say about the environment in contemporary public discourse--books, newspapers, magazines, radio-television and film--gives voice to many unresolved tensions within society itself over modernism. To understand those strains requires us to explore the cultural rsonances in the privileging of some issues over others (Hansen, 1991). Jim Detjen, a newspaper reporter at the Philadelphia *Inquirer* and president of the Society of Environmental Journalists, contends most journalists who cover environmental issues must find ways to balance competing social forces: "Virtually every veteran environmental writer I know has been threatened with the loss of his or her job at one time or another.... I've weathered some nasty campaigns...to discredit what I've written" (Detjen, 1991). Journalism is held simultaneously to be the linchpin and the scapegoat for those tensions (Jensen, 1990), but objective problems, organizations, and ideologies are all at work.[1]

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[1] Inglehart (1990) observed that the rise of the ecology movement is not simply due to the objective fact that the environment is in worse condition than it used to be, but owes its emergence to education, the expansion of global

Environmental discourse constitutes a revolutionary paradigm moving against the tenets of modernism and the ideology of progress (Taymur, 1982). Ecologism is a philosophy of interconnection and limitation; an infinitely expanding human system based on unrestrained consumerism is seen either as a case of prolonged ecological immaturity or pathological cancer (Weiskel, 1987).

Classical science, long the instrument of modernism, is simultaneously both foundation and anathema of ecological philosophy. Natural scientists have tended to view their roles as scientists and citizens separately. Environmentalists, by contrast, have understood these roles to be irretrievably linked. In a sense, classical science was dedicated to removing humans from nature, lifting them from natural limits. Environmentalism relocates humans in their natural environment:

> Even though environmentalism has clearly been pushed forward by scientific findings, there is a great gulf between environmentalism as a political movement and much of the scientific community. Environmentalists have been hostile to much of what science has offered society. Likewise, many scientists deeply resent the claims and style of environmentalists.... This mutual hostility is closely related to the mutual incomprehension.... (Paehlke, 1989: 115).

If classical science has objected to an environmental conscience, or its language of moralism, scientists have held fast to an economic imperative. Economics has been at the center of most of the decisions regarding the practice of science. Objectively, much of the abundance of the developed world has arisen from a science guided by an economic rationality. Such rationality is most apparent in public policies developed explicitly through cost-benefit analysis.

Yet, environmentalism is not as transparent as this portrayal might suggest. Environmental issues can be "messy" (Slocombe, 1989); or, more clinically, they can be characterized by uncertainty, spatial and temporal scale issues, complexity and competition. In

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awareness, and the gradually rising level of political skills among mass publics.

order to move toward resolution, issues are often reduced to fundamental technical causes without an accounting given for the discursive role of mass communication (Crowfoot and Wondolleck, 1990).

Communication about a new rhetorical domain like environmentalism inevitably crosses existing disciplines through a "discursive traffic" (Teymur, 1982). Even while it seeks its own legitimacy, environmental discourse can be appropriated and even dominated by other domains. In sum, environmental problems can be integrated into and distanced from an infinite variety of domains, including science, economics, politics, religion, education, etc. Although vocabularies and metaphors can merge across these functional domains, social theorist Niklas Luhmann predicts increasing problems coordinating across three levels of communication--interpersonal, organizational and societal: "As system levels become progressively more separate, as the three system types become increasingly distinct, problems related to interconnecting the dissociated levels become more and more acute" (Luhmann, 1982: 79). To trace these connections, it is desirable to focus on specific environmental issues rather than a constellation of problems (Van Liere and Dunlap, 1980).

In this essay I examine the differentiation of functional subsystems through mass media discourse about the tropical rain forest. I trace the origins of the rain forest as a theme of environmental discourse; how such a discourse originated in science and then diffused to political and economic domains. I argue that the dominant subsystem codes--truth, money and power--form a coordinated, interlocking mass communication pattern which is the framework for the social integration of environmentalism. Finally, I review evidence of religious discourse about the rain forest and its implications for mass communication.

LUHMANN'S THEORY OF SELF REFLEXIVITY AND SOCIAL INTEGRATION

Discourse analysis begins with the suspension, but not ignorance, of the reality of discursive objects. In semiological terms, the problem is the *signifier* not the *signified*. Environmental discourse might be constituted in a problem for which the referent may not exist in any concrete form at all (Teymur, 1982). On the other hand, a referent might exist and even impose an imminent danger to humanity, but it does not alter the analytical task.

This inquiry into environmental discourse is also informed by Luhmann's functional social theory which opens radical new horizons in communication theory through self reflexivity and autopoiesis. Departing from the dominant transmission model of communication, Luhmann proposes a model of society as a bounded system which constitutes itself and achieves its own rationality based on internal, rather than external, constraints. In this way, society evolves around communication between autonomous subsystems of science, economics, politics, law, religion, education, etc.[2]

Communication is enabled in the subsystems through separate media, or modes of exchange, such as money (economics), legality (law), truth (science), etc. Binary codes develop around these media assuring autonomy, but not necessarily self sufficiency. The legal subsystem, for example, defines questions in all-inclusive terms of the binary code ranging from "legal" to "illegal."

The codes tend to overlap and support each other. For instance, a political system is maintained through a code of power relations, but is sustained by an interlocking network of money and legality. Yet, the autonomy of a functional subsystem resides uniquely in its code: "The unity of every function system resides in being guided by a binary code valid for itself alone" (Luhmann, 1988: 133).

Luhmann's theoretical perspective focuses particularly on structures and processes which meet the integration needs of a larger social system, particularly along three dimensions: *temporal, material* and *symbolic*: (A) Time adds complexity by reaching into the past and embodies complex configurations of acts in the present and projects "horizons" of the future; (B) The material dimension deals with relations among actions (instead of actors) in potentially limitless physical space through interpersonal, organizational and societal levels; and (C) The symbolic dimension provides mechanisms such as "media" to correlate and coordinate human use of symbols.

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[2] While the subsystems are autonomous, Luhmann stresses, they are not self sufficient. See Luhmann, 1982: 142-145.

As an autopoietic system, society is simultaneously closed organizationally and open structurally. Society exists exclusively within communicative acts and defines its own boundary through the continual reproduction of communication by communication. Society produces all the components necessary to produce the very process that produces it. Thus, an autopoietic system creates its own boundaries in terms of self observation. Whatever is beyond the horizon of self observation is outside a system's boundary and comprises its environment. The boundary is porous and open to certain kinds of disturbances from the environment through resonance, and society reacts to its environment not through information transfer but through the common actualization of meaning through human action.[3]

Luhmann's work up to this point addresses environmental issues indirectly, but his recently translated work explores some of the specific issues arising from why society in general has significant difficulty in perceiving and addressing serious ecological problems.

Environmental Issues

Luhmann (1989) examines the complex interplay between social subsystems and the natural environment in terms of how society constrains dialogue about environmental issues. Consistent with his perspective of self reflexivity, Luhmann proposes that environmental information does not originate as information entering society from outside its boundaries, but is generated internally, consistent with overall system coherence.

Luhmann's work constitutes an alternative to the customary way to treating ecological problems in today's society, beginning with causes and then seeking responsibility for their effects. He argues for a radical change of approach since a virtually limitless number of causes exist for a given effect and intercepting causes is only one of the rational ways to define problems. Given that objective environmental problems exist, society must bring its own complexity into a relation of correspondence with the environment by reducing the complexity of the environment itself. The only possibilities a system can consider are those which can be meaningfully experienced and included in decision-making processes. The more drastic the means of reduction are, the fewer alternatives a system will identify to simplify its environmental complexity. If there are no internal processes to regulate internal imbalances between subsystems, to isolate causal responsibility, the only resource is to account for the problems through the environment. What results is a correspondingly simple image of the environment described in categorical and moral terms. Luhmann associates this kind of tension with the persistent rise of anxiety in contemporary society.

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[3] Turner (1986) is critical of Luhmann's approach for being unnecessarily teleogical; that is, societal system needs miraculously produce the structures to meet these needs. Such functionalism is essentially metaphysical: explanations are arrived at by intuition, not by deduction. Even while Turner allows for some "rich and robust substantive insights" (125), he insists Luhmann's approach has little to offer cumulative theory.

Luhmann's analysis of ecological communication may never gain popular momentum among environmentalists. To account for the dynamics of environmental consciousness through society's internal dynamics and not directly through knowledge inherent in nature itself betrays an otherwise naïve understanding of environmental reality.

Mass Communication

Luhmann alludes to some of the social functions of mass communication, although his analysis is not comprehensive (Luhmann, 1975; 1982; 1990). Mass communication is not communication in the usual sense of subsystem relations; it strictly limits the ways the principal social subsystems can fulfill their functions. "Mass media" are inadequately defined, he reasons, because the invention of writing already transcended the limitations of time and space in human interaction and served to infinitely expand the volume of accumulated data available for future self-reference in communication. In such an expansion individual actions take on social relevance only through the functional systems to which they are related.

Mass communication makes possible the evolutionary movement from personal/interactional, to organizational and societal levels of communication. "The world society would fall apart if structural changes reversed either the primary pattern of differentiation or the system of mass communication." (Luhmann, 1982: 248). On the other hand, a single world system must pay the costs of such a development. Mass communication is a catalyst that can outrun its own immediate effects, distorting the more natural integration of subsystem processes. This is accomplished because human action is based on imputed knowledge and as soon as information or opinions are published, common knowledge has to be taken for granted. Taking into account what others are presumed to know already changes the temporal dimension of experience and action.

In this way, Luhmann worries less about the effects of mass communication as persuasion than the foreshortening of perceptions of time, an issue which arises frequently in environmental literature. Immediate gratifications are pursued at nearly every social level at the expense of long-term relations with the the natural environment, thus speeding up action in the temporal dimension and contributing to the pressures of consumerism.

While mass communication may be developing to such a general level to become its own distinctive subsystem (Krippendorf, 1991), Luhmann proposes that every integrated function becomes a subsystem within a vast hierarchical arrangement of other subsystems, comprising the modern definition of society. The heuristic problem revolves both around the differentiation and integration of subsystems.

Mass communication is relatively opaque in terms of production processes and decisions, but is uniquely situated as a carrier of the discourses of other subsystems. For example, it is often explicit in mass communication to which functional domain a newspaper story refers, whether science, economics, law, religion, etc. The media distinctions might be blurred at times whether a news story arises from politics or law, but the integration of the two domains is usually understood in context, or is accepted as ambiguous. Similarly, the integration of environmental, scientific, political and economic domains is highly complex. We should examine the resonance capacity of function systems and how they respond to environment disturbances as given in the appearance of their respective codes in mass communication.

ENVIRONMENTAL DISCOURSE ABOUT THE RAIN FOREST FROM SOCIAL SUBSYSTEMS

Botanists categorize 30 or 40 types of rain forest, but the variations between them are continuous and largely ambiguous. The rain forest of the Brazilian Amazon region stands on particularly nutrient-poor soils and flourishes despite, not because, of its soil quality. The forest is sustained through nutrient processes which occur largely above ground level. Lush tropical vegetation has deluded generations of farmers who envisioned clearing forest growth for crops.

Europeans avoided confrontation with the Amazon forests until late in the colonial era. The Portuguese selectively cut and exported brazilwood and cleared land for sugar cane and coffee in coastal zones in the 1700s and 1800s. Cattle ranching and agriculture were maintained in relative balance with the population until the mid-1900s. Brazilians, especially recent Portuguese immigrants, held an aversion to the forest and justified deforestation. Ranchers were accorded higher status than farmers, leading to policies in favor of converting forest to pasture quite apart from development profits (McNeill,1986; Browder, 1988). With the rise of internationalism, population growth, export substitution and foreign debt, the pressure was directed to the undeveloped Amazon River region.

Seen from the unique cultural perspective of developed North America, the Brazilian rain forest is one of the marginal places left behind in the race for progress, a location which evokes both nostalgia and fascination (Shields, 1991). It is an international commons (Soroos, 1988); and a discursive site where place and subjectivity connect (Stallybrass and White, 1986).[4]

An environmentally-sensitive public understands the rain forests, together with the arctic regions, to be among the last wilderness regions on the planet. The connotative meaning carried by "wilderness" differs widely among those who adopt ecophilosophy, from deep and spiritual ecologism, to ecosophy, ecofeminism, social ecology, etc. (Nash, 1982; Oeleschlaeger, 1991). Some critics see American interest in the rain forest merely an ecological version of the old political/economic imperialism (Crosby, 1986; Weiskel, 1987).

As an environmental issue, the rain forest speaks, as do the other critical environmental problems, with moral force to those in tune with the rising Green agenda which holds that the earth is on a fast track to ecological catastrophe unless interventions can reverse the accumulated ecological abuse heaped upon the earth.

Science's Resonance Capacity

Science is a source of environmental resonance because of its historic integration into environmentalism as discussed briefly above. Yet, science, too, is a code-closed, autopoietic system which has limited resonance capacity to respond to disturbance in the environment. The medium of science is truth, or as Luhmann explains: "The difference between true and false is what matters for science's code" (1989: 76).

While seeking to establish the "difference" in science's code, scientists have directed their efforts toward the acquisition of new knowledge through a reification of curiosity. Significantly, while science's technical skills can be applied to technical crises, science's goal is not to solve problems per se but to multiply them. This is accomplished under pressure from various sources in society (Winsten, 1985). Environmental problems are the natural byproduct of science's functional differentiation.

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[4] Such intense interest in not without its ironies: the survival of the rain forest depends simultaneously on being left alone *and* on human intervention.

Many biological scientists have been realistic about the problems of penetrating the mysteries of a tropical ecosystem. Jared Diamond, a tropical biologist at the University of California at Los Angeles, and an advocate for rain forest preservation, recounted advice given to science graduate students in the 1950s: "The tropics are hopelessly complex. You'll ruin your career by trying to work there. If you want to understand ecology, go to the Arctic, where there are few species, and where ecology is much simpler" (Diamond, 1990: 22). Casting aside all caution, Diamond went to New Guinea in the early 1960s to study bird habitats and struggled to grasp the complexities of life there. Instead of the intricate "web of life" he hoped to find in the rain forest, he found a "uncomfortable, difficult, dangerous, and politically tricky place" (22). With patience and persistence, Diamond eventually found what he sought: "It [tropical forest] overwhelms us by its detail. Underneath that detail lie nature's laws, but they don't cry out for attention. Instead only by listening long and carefully can we hope to grasp them" (27)

In the mid-1880s $40 million was spent annually on tropical biological research, half of which came from the United States. According to the National Science Foundation, about 4 thousand world scientists are primarily interested in tropical ecosystems, half of whom are taxonomists. While half of all tropical biologists are North Americans, the total number of scientific papers published each year on environmental biology in the U.S. is greater than the total published on all aspects of tropical biology worldwide. Only three Americans were engaged in large-scale tropical studies in 1985.[5]

The threat to the rain forests first arose in the United States from within a continuing dialogue about development issues among scholars interested in Latin America. Since the 1950s, the central Brazilian government adopted an aggressive policy of economic growth driven by industrial growth. Government technocrats were slow to recognize environmental issues. The Minister of Planning told American journalists in 1972: "Brazil could happily become an importer of pollution, as it has a lot left to pollute" (Vieira, 1985: 106). In 1973 a technical description of the impending threat to the tropical forests appeared in an American geography journal (Denevan, 1973). Both *Time* and *Newsweek* magazines published brief articles about problems of population incursion brought about by the Trans-Amazon Highway.

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[5] The New Yorker, January 14, 1985, p. 71.

The first generalized science discourse about the rain forest through mass communication appeared in 1979 in the science section of the *New York Times*. Journalist Bayard Webster framed the rain forest problem in terms of its biological complexity and the threat posed by abuse. The *Times* described the tropical forest as: "A complex and threatened world," estimating that 20 to 35 percent of the earth's atmospheric oxygen originated in the rain forests. Webster linked the ultimate cause of deforestation to population growth, but more immediate specific problems were: agriculture, cattle-ranching and logging. Fast-food restaurants in the United States were identified as the principle financing for Costa Rican beef production. The loss also was linked to the potential loss of scientific information: "[R]ain forests...will be leveled by the year 2,000 before ecologists and forest science experts can learn how so many different plants and creatures can live together and how they might benefit mankind."[6]

Thomas E. Lovejoy, vice president of the World Wildlife Fund, described efforts by the Brazilian government to "stem the destruction."[7] Lovejoy attributed the problem to access permitted by the Trans-Amazon Highway. "The apparent fertility of the forest soil had led Brazil...to try to exploit it for economic reasons," Lovejoy said.

The New York newspaper sought to localize interest in the international problem by connecting a decrease in the number of migratory songbirds to North America to tropical deforestation, using information from the Smithsonian Institution: "[R]esearch shows a definite correlation between the rate of forest destruction and...decrease in population of migratory songbirds."[8]

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[6] New York Times, April 17, 1979, P. C1.

[7] New York Times, Nov. 20, 1979, P. C3.

[8] New York Times, August 12, 1980, P. C1.

Times writer Warren Hoge filed a report from Rio de Janeiro based on a report issued by the National Academy of Sciences in Washington, D.C., affirming: "Development is eating up the world's rain forests." The report's author, Norman Meyers, wrote that 50 million acres of rain forest--an area the size of England and Scotland--was destroyed each year. Two-thirds of the Southeast Asian rain forests and half of the African forests already already had been destroyed and "scientists want to draw the line at the Amazon...the least savaged by man."

For the first time, the *Times* linked tropical deforestation to global warming:[9] "One disaster scenario envisions a two-degree rise in the world's temperature within 70 years because of the carbon released into the atmosphere by forest destruction, melting polar ice masses and raising sea levels as much as 23 feet...."[10] An artist's rendering of San Francisco under ocean water was published in a national Sunday newspaper supplement.

If natural scientists were ever reluctant to penetrate the intricacies of the rain forest, they were to discover its private and public rewards. Thomas E. Lovejoy of the World Wildlife Fund affirmed in the *New York Times* in 1986 that natural scientists now have much at stake in placing the tropical forests on the public agenda.[11] Scientists promoted the potential human benefits of the rain forest in terms of future foods, drugs and other consumer products, in order to build political support for their research,

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[9] A study of national newspapers for the period 1986-91 indicated global climate problems were defined in newspapers coverage initially by climatologists and eventually shifted to policy makers. Unpublished paper, "Newspaper Coverage of Global Climate Change by Five Papers," by Sujata Moorti, the Center for Global Change, University of Maryland, October 1991.

[10] New York Times, August 31, 1980, P. 16E.

[11] The persistent challenge for scientists has been to find ways to communicate to the American public. In a review of literature on mass media and science, Dorman (1990) found widespread dissatisfaction among scientists for what they perceived to be the failure of journalists in capturing and conveying science to the public: "... deficiences of the press recur throughout the literature as a leitmotif. The corpus is rife with anecdotes illustrating how the fourth estate has ignored, misunderstood, or otherwise misrepresented scientific work" (51).

Lovejoy said.[12] He described the Amazon rain forest as "a huge pharmaceutical factory," revealing both a dominant machine metaphor of classical science and a utilitarian bias. He also affirmed a paradox of technical rationality: "The answers to many of the demands of our ever more hungry and growing population lie in the very eco-systems which these demands pressure us to destroy"[13]

A commentary written by Roger Stone of the World Wildlife Fund in the *Times* promoted the conception of the forest as a "biological warehouse."[14] The loss of a substantial part of the forest means: "America's cornbelt could become a subtropical region...." Stone rejected the idea that destruction of the tropical forests was inevitable, just as was the clearing of forests in the United States and Europe, an "inevitable and desirable consequence of economic progress."

In 1975 Robert J. Goodland and Howard Irwin described the impending development of the Amazon forest in *Amazon Jungle: Green Hell to Red Desert* (1975), followed by Alex Shoumatoff's *The Rivers Amazon* (1978). The collective was framed in the vocabulary of science. If deforestation of the rain forest generally, and the Amazon forest in particular, continued at then-present rates, as many as 25 percent of all living species inhabiting the earth in the mid-1980s will have disappeared by 2015. The moral imperative as defined by the World Resource Institute:

> As the twenty-first century nears, we are "eating our seed corn," squandering in a heedless evolutionary moment the forest's genetic capital, evolved over billions of years. The price for doing so is biological impoverishment in the years ahead and a consequent ecological decline that will threaten the health, commerce, and quality of life enjoyed by developed and developing nations alike." (Miller, Reid and Barber, 1991: 79)

Although estimates vary widely, a United Nations study estimated 11 million hectares of tropical forest were being destroyed each year in 1980. In 1990, the estimate was doubled to 16 to 20 million hectares. From two to five million of all living species in the forests had vanished. The loss included 70 percent of the plants that possess anticancer properties. In addition, forest degradation and depletion caused the disappearance of 87 of the 230 original indigenous Amazonian tribes in South America. Similar data has been assembled from the tropical forests of Africa, Southeast Asia and the South Pacific. Rain forest destruction constituted "an unprecedented raid on the planet's biological wealth" (Miller, Reid and Barber, 1991: 79).

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[12] The New York Times, September 16, 1986, p. C-3.

[13] Ibid.

[14] New York Times, Nov. 8, 1986, p. 31.

In Congressional hearings in 1980, the Subcommittee on International Organizations considered the accumulating evidence of rain forest problems.[15] After hearing from natural scientists, industrialists and government officials, the panel tried in vain to balance all interests. They proposed a reduction in the rate of deforestation "with any large-scale forest clearing the result of deliberate, enlightened decisions by government"[16]; an increased flow of wood and wood products through expansion of the wood industry; and development of a new understanding of forest carbon dioxide relationship to the climate.

Theme Transitions

Although the separation of discourse themes is not necessarily found in a distinct event, a number of mass media developments signaled a broadening of issues in the rain forest discourse. In particular, Catherine Caufield's *In the Rainforest* (1985) opened the spectrum of discussion into the complexities of the rain forest in terms of hidden actors.[17] Early accounts of the rain forest's problems virtually ignored Indians and other forest dwelling peoples. An extended article by Caufield in the *New Yorker*[18] outlined some of the diverging interests in the forest.

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[15] Hearings in the Subcommittee on International Organizations, Committee on Foreign Affairs, U.S. House of Representatives, May 7, 1980, Washington, D.C.: U.S. Government Printing Office, 1981.

[16] Ibid, p. 10.

[17] Caufield's book subsequently has been published in 13 languages, the most widely disseminated treatise on rain forest issues.

Caufield's account was appropriated by diverse groups as rhetorical support for their agendas. On one hand, she offered a view of the "colossally twisted workings of big business and the so-called development institutions that are the primary funders of rainforest destruction" (Mills, 1990: 49). She introduced a new issue in the public debate: the cut-and-slash burning of the forests that could precipitate important changes in the global climate and destabilize the polar ice caps. Prior conceptions had linked the importance of the forest to the global climate in terms of oxygen-producing capacity. She demythologized the claim that rain forests produce a large proportion of the earth's oxygen: "They consume as much oxygen in the decay of organic matter as they produce through photosynthesis."[19] In August 1988, the *Times* published a composite satellite image of vast areas of slash fires at night in the Brazilian forests, to illustrate the extent of slash-and-burn strategies in terms of the connection to global warming. The newspaper cited estimates that rain forest fires accounted for perhaps one-tenth of global carbon dioxide emissions.[20]

Looking beyond immediate natural science issues, Caufield hypothesized the causes of deforestation were probably economic and political, although they had scientific consequences. She wrote: "[T]he true cause of agricultural settlement in rain forests is often inequitable land distribution rather than simple overpopulation."[21] She located the problem on government-sponsored settlement schemes, intended mainly to establish a civilian presence in frontier regions. Other causes she identified--cattle ranching, large-scale logging operations, hydroelectric dams, mines, and industrial development--cumulatively had little direct connection to population pressures. In concrete economic terms, she said the destruction of the Central American rain forest takes five cents off the price of an

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[18] New Yorker, Jan. 14, 1985, pp. 41-101.

[19] Ibid, p. 62.

[20] New York Times, August 12, 1988, p. 6.

[21] Ibid, p. 49.

American hamburger, since two-thirds of all Central American beef exports are bought by Americans. Much of the needed pastureland for cattle ranchers is cleared from the rain forest.

Caufield wrote with sympathy about the problems of poverty among land-hungry subsistence farmers in the Amazon leading them to torch the forests. The only answer was for the farmers to learn ecologically-specific farming techniques from Indians who had long since adapted to the necessities of rain forest climate and soil conditions. Science is ill-equipped to investigate or understand the tropical biome: "The complexity of a tropical rain forest sometimes strains the crude framework of modern biology, which was derived from the much simpler ecosystems of the temperate zones."[22]

After the *New Yorker* published Caufield's analysis, a new wave of media attention about the forests appeared. *Newsweek* featured an article "The End of Eden," sympathetically reviewing Caufield's book, as well as *The Primary Source* (1984) by Norman Myers; *Tropical Nature* (1984); and Roger Stone's *Dreams of Amazonia* (1985).

Economic Discourse

While discourse about the rain forest found its way into mass communication through the rhetoric of science it soon opened into political and economic domains. The differentiation between these functional subsystems was marked by their varied logics, themes and vocabularies. Each discourse displays varying degrees of resistance to societal integration, fulfilling particular professional and cultural functions. In Luhmann's analysis, the economic function system deserves primary consideration, although there are clearly limitations to transactions by money in other subsystems. The economy is a closed, circular, self-referentially constituted system based on the exchange of money.

The economic system is closed in that it does not exchange money with the environment. The environment is regarded as the storehouse of all naturally available resources in the cycle of production and consumption. Environmental questions can be addressed through the economy's capacity to react to resonance. Consumption patterns can be changed through value and attitude shifts, but Luhmann believes there is no way to predict how such changes will work out and what side-effects they will trigger in the economy.

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[22] Ibid. p. 50.

Dialogue about the economic dimensions of the rain forest frequently focused on two topics in the *New York Times*: the international business interests which have become entangled in exploitation of forest resources; and the alternatives of land-hungry farmers and urban peasants caught in an economic squeeze over use of the forest's resources.

Several conservation agencies sought to work out details of elaborate financial exchanges which would relieve huge debts in the Latin American countries in exchange for rain forest preservation. In one such agreement, the World Wildlife Fund and the Nature Conservancy bought at a discount $9 million of Ecquador's debt from American Express Co. and Morgan Guaranty Trust Co. The proceeds were to be spent on local currency bonds to conserve rain forests.

Writer Marlise Simons wrote a series of forest-related articles on economic issues in 1989. In her stories, the *Times* focused on an estimated 300,000 people who use forest products in non-destructive ways, such as rubber-tappers and others who collect nuts, resin and other forest produce[23]; a cost-benefit study which discovered that rain forests are worth more economically if left standing than if cut for timber or cattle grazing. Environmentalists were quoted in the story agreeing that such findings could slow the pace of large-scale clearing of the forests[24]; and an effort by farmers to raise iguanas for food, under a headline: "A plan to save iguanas, and the rain forests in the bargain."[25]

The *Times* also discussed coca growers who cleared parts of the Amazon forest with toxic chemicals to grow cocaine for export to the

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[23] New York Times, April 1, 1989.

[24] New York Times, July 4, 1989, p. 1.

[25] New York Times, Aug. 22, 1989, p. C-4.

United States and Europe.[26] Later, the newspaper described further economic efforts of environmentalists to create a market for nuts, fruits, roots, pigments and oils to displace further deforestation by lumber and cattle interests.[27]

In 1985, the *Times* contained a report on an elaborate $8 million World Resource Institute proposal "to save the world's rapidly disappearing tropical forests." The article repeated the premises then generally accepted as the causes of rainforest destruction: "While corporate timber and cattle operations are responsible for some forest loss...the real causes of deforestation are poverty, skewed land distribution and low agricultural productivity."[28]

A few days later, the *Times* supported the WRI funding proposal in a lead editorial which escalated the rhetoric: "The Rape of the Rain Forests." The editorial also broadened the blame for deforestation: "Colonizing the forest deflects the pressure for land reform," it argued. "The governments of nations endowed with rain forests are principally to blame, but foreign loans have abetted the rape." The editorial reasoned: "Destroying rain forests is a means of avoiding tackling real problems by pursuing chimeras: a 'license to print money' which yields quick cash at the cost of ultimate catastrophe."

Economic criticism of environmentalism in the mass media, while relatively infrequent, may serve to delegitimize a particular discourse theme, but serves to maintain the functional subsystem. For example, the conservative business magazine *Forbes* criticized the radical environmental organization Greenpeace in a cover article, accusing its founder David McTaggart of manipulative control of the media for selfish purposes. A Greenpeace critic offered this account of the movement's success: "You are what the media define you to be. [Greenpeace] became a myth, and a myth-generating machine."[29] The magazine's dominant discourse, economics, faulted McTaggart's motives, but offered an otherwise admiring account of how Greenpeace's revenues of $157 million in 1990 were the result of an economic genius. Ironically, the economic discourse at *Forbes* was appropriating environmentalism as the very basis of criticism of a successful environmental organization for its economic success. This exemplifies the closed nature of economic discourse, even in the face of a tide of rising public environmental awareness.

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[26] New York Times, Aug. 13, 1989, p. 1.

[27] New York Times, April 30, 1990, p. D-12.

[28] New York Times, Oct. 29, 1985, p. C-9.

[29] Forbes, November 11, 1991, p. 174.

Political Themes

Politics is the most opaque of function systems even while it claims a central position in society. Politics code is power which can be interposed in the legal, economic and scientific systems, but politics tends to follow the general course of a differentiated function system. Luhmann finds no compelling reason to assign politics the leading role in environmental problems; it cannot act outside of its own autopoiesis or its own code and requires long-term perspective.

Politics has at least two practical limitations in its resonance capacity to the global environment problems: first, politics is limited by national boundaries; second, there is no well developed legal system through which politics can be applied internationally. There are few legal standards of environmental law and little hope for legal recourse to violations of such law.

Luhmann contends that of all subsystems, the political is the least defined. He proposes, however, that the political system operates primarily through roles. "Only at the level of roles can [political]...process of differentiation be carried out unambiguously, so that it is usually recognizable whether a role (e.g. civil servant, member of parliament, party secretary, voter, or petitioner) can be attributed to the political system" (1982: 140).

For some who practice environmental politics, the mass media are an important instrument for political action. The Sierra Club has placed a high priority on infusing information into the mass media, particularly through television programming and investigative reporting:

> If we are going to mobilize Congress to preserve the rainforests, we have to get current rainforest issues regularly into the evening and morning news. It's up to the coalitions to supply current information to the media and pressure them to take global forest issues to heart and report on them--not only through occasional specials on public or cable television, but also on the regular news programs of the major commercial networks (Milton, 1990: 240)

Whether engineered as publicity or spontaneous, the national news media have raised the rain forest issues with increasing frequency. Exposure alone contributes to a sense of legitimacy, both for the theme and the functional subsystem. A *New York Times* story in 1986 characterized the rain forest as a public relations problem for American scientists. Biologists, especially taxonomists, were described as escalating efforts to save the rain forests: "[They are] fearful that a significant share of living species will disappear before they are even discovered."[30] The central issue, as some biologists viewed it, was the dramatic progress in molecular biology that had "stolen status and resources from the task of describing and comparing different forms of life."[31]

If the journalism coverage revealed a political domain of concern to scientists, it began to expand into other themes, occasionally through a persona. The American press seemed to seek out spokespersons for the rain forest, identifying heroic, if eccentric, figures who were interested in the rain forest. Among some of the personalities profiled in the *Times* were forest artist-explorer Margaret Mee[32]; photographer Frans Kracjberg, who used "art as a sword to defend Brazil's forests"[33]; artist Bruno Manser, who chained himself to Westminster Abbey during an economic summit to call public attention to the Borneo forests.[34] Rock singer Sting formed a coalition with Raoni, an Amazon Indian, to petition Brazil to designate the Xingu National Park in the Amazon as a national reserve to protect 17 tribes that live there.

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[30] New York Times, September 16, 1986, p. C-3.

[31] Ibid.

[32] New York Times, December 4, 1988, p. 60.

[33] New York Times, Oct. 17, 1989, p. C-17.

[34] New York Times, July 28, 1991, p. 6.

By the late 1980s, after pop celebrities and upscale marketers such as Sting, Madonna,[35] the Grateful Dead, Hermé and others, defined the tropical forest as a popular cause, there was in place an interlocking dependency between mainstream science, popular culture, environmentalism, and the mass media. They all benefited, each in their own narrow way, from the unlikely network of dependencies all focused on the rain forest.

Mendes: The Eco-martyr

Environmentalists in the United States and Europe formed a coalition with rubber-tappers in the Amazon when cattle ranchers began cutting rubber tree stands to open new pastures. Brazilian rubber tappers were seen as militant guardians of the rain forest because they lived in harmony with existing ecology. The *Times* editorialized that rubber-tapping was a sustainable economic alternative to cutting down the forest without detrimental effects to the local population.[36]

Francisco "Chico" Mendes, a Brazilian labor activist, was profiled in the *Times* in September 1987, when he traveled to Washington to protest tropical deforestation at the annual meetings of the World Bank and the International Monetary Fund.[37] Mendes was awarded the United Nations Environmental Program Global 500 award in 1987.

Mendes' persistent efforts to affirm social justice and preserve the forest ecology led to frequent violent confrontations with cattle ranchers. He was on a blacklist of a confederation of ranchers in the Acre region, the Rural Democratic Union. The subsequent murder of Mendes in December 1988 was inspiration for an outpouring of media environmental interest. In short order, he was described as an eco-martyr, a sacrifice for the cause of the rain forest.[38] Noting the intense media interest in the death, ecologist John P. Milton described the unprecedented attention in the international media. "Such coverage, unimaginable only a few years ago, ups the ante in the battle to save the rain forests" (Milton, 1990: 238).

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[35] Madonna hosted a fundraiser named "Don't Bungle the Jungle," which raised $500,000 for rain forest preservation (New York Times, May 26, 1989, p. B-3).

[36] New York Times, September 20, 1989, p. 26.

[37] The proposal subsequently acted upon by the World Bank was to designate areas of the Amazon as reserves where only sustainable economic activity, such as rubber tapping, would be permitted. New York Times, September 29, 1987, p. 8

The *Times* had published a series of articles and editorials late in 1988 about the difficulties facing Brazilian President Jose Sarney and indiscriminate burning of the forests. When Mendes was killed, the newspaper published a front-page article about Mendes' death, an editorial criticizing the Brazilian government for its inadequate efforts to protect the forests and Mendes, and followed with a series of front-section articles about the search for and prosecution of his assailant.[39]

Among the volumes subsequently published about Mendes' death were: *The World Is Burning* (Shoumatoff, 1991); *Fight for the Forest* (Mendes, 1989); *Into the Amazon: The Struggle for the Rain Forest* (Dwyer, 1990); *The Burning Season: The Murder of Chico Mendes and the Fight for the Amazon Rain Forest* (1990) by Andrew Revkin; and *The Fate of the Forest: Developers, Destroyers and Defenders of the Amazon* (1990) by Suzanna Hecht and Alexander Cockburn.

Feeling the political pressure of worldwide exposure, Brazilian President Sarney complained to visiting U.S. Congress members Timothy E. Wirth and Albert Gore in January 1989 that Brazilian sovereignty was threatened by the international movement to preserve the rain forests.[40] The Brazilian government expressed its impatience with "foreign meddlers and critics" who were trying to embarrass it with an international outcry against the destruction of the Amazon forests.[41] The rising international interference amounted to political subversion, according to Brazilian officials, and they launched a campaign to fight back politically.

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[38] The designation "eco-martyr" originated from Alex Shoumatoff in "Murder in the Rainforest," in Vanity Fair, September 1989.

[39] The New York Times editorialized on September 20, 1989 that U.S. senators should not criticize Brazil's President Sarney for failing to do enough to save the Amazon forests because the U.S. government was itself subsidizing the destruction of the Tongass National Forest in Alaska.

[40] New York Times, January 22, 1989, p. 9.

When a new Brazilian president, Fernando Collor de Mello, took office in February 1990, he was described by *Times* writer James Brooke as being receptive to foreign criticism of Brazilian development policies in the rain forest.[42] A few days later, Fernano Mesquita, head of the Brazilian Environment Institute, criticized foreign governments for not contributing monetary aid to the cause about which they claimed to be so passionately attached. The clashing codes of differing subsystems was never so painfully evident.

SUMMARY: ANTICIPATING NEW THEMES IN ENVIRONMENTAL DISCOURSE

From the web of subsystem discourses about the tropical rain forest arise these consequences: (1) a proliferation of environmental issues and their defined causes; (2) an increased interest by mass communication managers in examination of these issues; and (3) a rise in public anxiety over unresolved environmental problems leading to new, emergent discursive themes.

An Evolving Agenda

The expanding environmental agenda is self evident. Rain forest issues have multiplied and evolved. While environmental waste has always been disturbing to some individuals, it acquired an international scope when Brazil wantonly cleared its primeval forests. Economics defined the forest, as it has done traditionally, as a resource. Science initially defined the rain forest in terms of taxonomy, for its biodiversity; later for its value to the global atmosphere and climate; and then as a warehouse of undiscovered food and medicines. The interests of indigenous people, both Indians and subsistence farmers, although always of interest to cultural anthropologists, became a public issue almost as an afterthought.

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[41] New York Times, March 23, 1989, p. 14.
[42] New York Times, Feb. 12, 1990.

The World Resources Institute produced a Tropical Forestry Action Plan to define the causes of rain forest deforestation and its consequences (Winterbottom, 1990). The organization published the 56 underlying economic and political development issues which might affect the survival of the rain forest. Development funds, they have discovered, may not penetrate the complex maze of problems.

The Sierra Club's *Lessons of the Rainforest* (Head and Heinzman, 1990), is a testament to the obfuscation of rain forest as a cultural dilemma. The book draws on the perspectives of specialists in ecology and other natural sciences, political scientists, humanists and environmental activists. They conclude that the rain forests have suffered simultaneously from development banks, short-sighted capitalists, greedy overlords, land-hungry peasants, Western consumer appetites, the Industrial Revolution, technology, etc. With virtually an infinite network of causes recognized behind deforestation, there are also infinite opportunities to assign blame for those causes.

Moral Dilemmas

To reiterate a key principle in Luhmann's theory, if society lacks internal processes to isolate causal responsibility, the only recourse is to account for the problems through redefinition of system boundaries, to reduce the complexity of the environment. What results is a correspondingly simplified image of the environment described in categorical and moral terms. Attention to the contradictions in social metaphors of (e.g. nature as "machine," "organism," etc.) is a form of categorization which serves transparently to express ideological values and cultural practices (Oelschlaeger, 1991; Botkin, 1990).

Moralism leads inevitably to moral diversity and disagreement. Moreover, it raises the question of comprehension: "[I]f two cultures employ quite different moral languages, each with its own characteristic concepts and styles of reasoning, might they not have too little in common even to disagree? Could they understand one another at all?" (Stout, 1988: 61). Luhmann reaches a similar conclusion, predicting organizational and societal fragmentation over environmental problems. Anxiety which results from the unresolved tensions in environmental discourse is not necessarily dissipated by mass communication. As discussed in a recent study, when mass communication is virtually the only source of surveillance of environmental danger, a considerable level of confusion and misinformation results:

> The literature on disasters and disaster warnings is replete with evidence that the nature of the danger confronting the community and the available courses of action are poorly understood by large segments of the community. In part this stems from deficient communication by scientists, public officials, and the mass media (Turner, Nigg, Paz and Young, 1980: 26)

To recast those findings in Luhmann's perspective, misinformation and anxiety are achieved through mutual understanding, not deficient communication.

A Religious Turn

As illustrated above, environmentalism is entwined in the discursive struggle between societal subsystems--science, politics and economics--but is not limited to them. In the paradigm of modernity (e.g. the ideology of progress) an appeal to traditional truth, myth or religion has been inadequate to address contemporary issues.

Luhmann agrees that religious practice holds little promise for environmental discourse: "[Religion] will have little to contribute to the social resonance to the exposure to environmental dangers" (98). Further, he muses: "One almost gets the impression that religion today develops as a kind of parasite on social problem situations...." (99).

The question of a religious answer to environment practice is not settled so easily. Luhmann affirms that his theory is not normative, rather it is "to work out how society reacts to environmental problems, not how it ought to or has to react if it wants to improve its relation with the environment" (1988: 131). However, there are ripples of movement toward a religious solution.

A religious theme in environmental discourse is identified with John Muir who believed he was engaged in a form of nature religion saving sacred spaces, places of healing, renewal and worship. "The clearest way into the Universe is through a forest wilderness," wrote Muir (Teale, 1954: 312) "In God's wildness lies the hope of the world" (315). The Judeo-Christian roots of Western society's domination of nature was problematized by Lynn White, Jr. and Arnold Toynbee and politicized by the bureaucratic practices of U.S. Secretary of Interior James Watt (Calicott, 1990; Vecsey, 1985).

The dialogue about restoring the concept of the *sacred*, a place for religion and god in nature practice has continued since Muir, if only within the confines of a narrow theological domain (Carmody, 1983; Cherry, 1980; Hart, 1984; Hendry, 1980; and Hughes, 1983). Richard K. Nelson (1990) has outlined some of the common cultural and philosophical parallels between the rhetoric of Christian fundamentalism and social environmentalists. He also has defined the central place of religiosity in the Alaskan Koyukons' tribal ideology and practices (Nelson, 1983). Sheldrake (1991) goes even further, examining ways of thinking about nature both with and without god.

Some elements of American environmentalism are rediscovering religious discourse as a healing method, a path of harmony, or a holistic center (Albanese, 1990). In its call for political action on behalf of the rain forest, the Sierra Club legitimates the practice of meditating or praying for the cause: "[T]he protection and regeneration of the tropical forests and their peoples would be a direct step toward acknowledging the fundamental truth that the Earth is sacred" (Milton, 1990: 244).

The abandonment of the sacred during the Enlightenment was associated with the idealization of reason and its disciplines. Enlightenment philosophers held that reason could replace the sacred and preserve the movement of society into its utopian future. Since at least the 17th Century, democracy was the embodiment of public reason (Nisbet, 1980). Economics and science were its instruments. A religious turn in environmental thought is symptomatic of the declining faith in technocracy because of its moral ambiguity.

The social integration of economics, science and politics in environmental discourse, leading to a modest, if utilitarian, revival of religion is not a trivial development for mass communication. Whether mass communication would accommodate a religious turn in the short term is doubtful. Sacrilization of public discourse would require dismantling the ideology of objectivity in the professional practice of journalism and developing a means to allow for public religious practice. The rational mind rules in organizational and societal functions and for religious discourse to penetrate into those levels in a post-materialist society would require a revolution of as yet inconceivable proportions.

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The Science Newswriting Process:
A Study of Science Writers' Cognitive Processing of Information

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Paper Presented to the
Association for Education in
Journalism and Mass Communication
Magazine Division
Science Writers Educators Group
Montreal, Canada
August 1992

Montreal, Canada, August 1992

Abstract

This study traces science writers' cognitive processing of information through the use of think-aloud protocols. The science writers who participated in this study spent about 23 percent of their time planning and writing, 4.5 percent editing and 2 percent considering journalistic constraints. They spent little time on prewriting planning, relied more on local than global plans and used more content than organizational plans. The science writers' processing of information can be explained by considering the contextual constraints they face.

Abstract

The writing process is a complex cognitive activity that requires writers to initiate an array of activities. This study investigates the writing processes of five professional science writers through the use of think-aloud protocols to record science writers' verbalizations of their thoughts as they write articles at scientific conferences. This study focuses on four of the primary tasks the science writers initiated while writing: planning, composing, editing, considering constraints.

Based on quantitative and qualitative analyses of the science writers' protocols, this study found that they initiated many of the same tasks other writers do, but the ways they carry out these tasks and the frequency with which they employ them differ. On average, the science writers spent equal amounts of time planning and writing -- an average of 23 percent for each activity. They spent only a little more than 4.5 percent of their time editing and about 2 percent of their time considering constraints. They spent little time on prewriting planning, relied more on local plans than global plans, used more content plans than organizational plans and referred to the constraints under which they worked.

The ways the science writers' processing of information differs from other writers' can be explained by considering the contextual constraints they faced. Journalistic conventions appear to have a significant impact on the science newswriting process.

The Science Newswriting Process: A Study of Science Writers' Cognitive Processing of Information

Introduction

Much of the research on the science news production process focuses on how science writers gather information for their stories. Researchers have examined how science writers select story ideas (Dunwoody, 1978, 1979, 1980), scientific sources (Goodell, 1977; Shepherd, 1981; Dunwoody and Ryan, 1985; Dunwoody, 1986) and information (Dunwoody, 1978; Dunwoody and Kalter, 1991; Stocking and Gross, 1989). However, few studies look beyond the **newsgathering** process to the **newswriting** process. Research on the newswriting process is important because it is during this stage that science writers make final decisions about the content, structure and style of their articles.

Researchers have provided numerous recommendations about the strategies they think science writers **should** use during the science newswriting process. Researchers have identified specific textual features that they claim will improve the readability of science news articles (Tarleton, 1953; Funkhouser, 1969; Funkhouser and Maccoby, 1971; Funkhouser and Maccoby, 1973; Kwolek, 1973; Bostian, 1983; Bostian and Byrne, 1984), liven up the style (Reddick, 1969; Funkhouser and Maccoby, 1973; Kwolek, 1973; Grunig, 1974; Hunsaker, 1979; Shapiro, 1986; Dowdey, 1987) or improve explanations (Rowan, 1988a; Rowan, 1988b; Rowan, 1990a; Rowan, 1990b; Rowan 1990c). But, these studies do not look at the strategies science writers use during the science newswriting process.

This study draws on theories and methodologies from two different research traditions -- composition studies and mass communication research -- in order to explore the science newswriting process. Specifically, this research uses think-aloud protocols to capture five professional science writers' verbalizations of their cognitions as they write stories at scientific conferences. This study was conducted in a naturalistic setting in order to preserve the conditions and contextual constraints science writers usually face.

Literature Review

The Writing Process

Most of the empirical research on the writing process has been conducted by composition theorists and researchers (Emig, 1971; Flower, 1977, 1979, 1987; Flower and Hayes, 1980a, 1980b, 1981, 1984; Berkenkotter, 1981, 1983; Faigley et al., 1985; Bereiter and Scardamalia, 1987; Hayes, 1980, 1989; Nystrand, 1982, 1986; Odell and Goswami, 1982, 1984). These researchers have studied the cognitive processes writers initiate as they retrieve, activate and modify knowledge structures or schemas during each of the stages of the writing process: planning, drafting and revising.

Writers orchestrate a variety of distinct thinking processes as they write. Writing is a complex problem-solving process during which writers transform thoughts into words (Flower and

Hayes, 1981). The writing process includes three distinct stages or phases: planning, translating and reviewing stages of the writing process. Writers do not follow these stages in a linear sequence of steps, but in a hierarchical manner with no fixed or rigid order of stages (Flower and Hayes, 1981).

Planning often is the first stage writers initiate when writing, although writers continue to plan throughout the entire process while as they decide what information to use in their articles and how to present that information. Planning provides writers with pointers about what they should do (Flower and Hayes, 1984). Kucer (1985) defines a plan as a "tentative map of action." Writers develop these maps at the macro-level, global plans, and at the micro-level, local subplans (Kucer, 1985). In addition, writers also create goals or objectives throughout the planning stage. Macro-level goals specify the writer's overall objectives for writing or communicating, while micro-level goals refer to the writer's goals for particular portions of the text.

Another stage of the writing process is the drafting or translating stage. During this stage, writers articulate thoughts and knowledge stored in long-term memory and express them using written language. Writers store information in long-term memory as cognitive structures or schemas (Flower and Hayes, 1981). During the writing process, writers continually activate and retrieve these schemas, which contain information about the topic, audience, writing plans and writing problem representations (Flower and Hayes, 1981). Writers use this knowledge to transform information into a form that will be familiar and accessible to the reader (Bracewell et al., 1982; Flower and Hayes, 1984).

Another stage of the writing process is reviewing or editing. At this stage, writers evaluate and revise their texts (Flower and Hayes, 1981). Writers can initiate editing at any time during the writing process. Editing often generates more planning and writing.

Research on the Newswriting Process

Few attempts have been made to extend cognitive theories of writing to nonacademic discourse like journalism. Although a great deal of anecdotal information is available on the newswriting process, empirical documentation is scarce (Pitts, 1982, 1989; Schumacher et al., 1989). Such documentation is even more scarce for specialized newswriting, like science writing.

Research conducted by Pitts (1982, 1989) documents some of the cognitive activities journalists initiate during the newswriting process. Pitts (1982, 1989) found that journalists spent one-fourth to one-third of their time writing the lead, and that lead writing helps them plan the direction of their story. She also found that journalists did not set global or macro-level plans for the article, but set local or micro-level plans. They concentrated on planning, writing and editing one section of the article at a time.

Schumacher et al. (1989) studied 24 newswriting students and found that students who wrote news stories used "a highly constrained, preorganized, genre-controlled strategy" (p. 400). They used detailed schemas for determining the organization of the story, used a preorganized structure for their articles, wrote under the linguistic constraints specified by a style manual and showed much concern about the accuracy of their writing.

Methods and Operational Definitions

Data Collection

In this study, protocol analysis was used to examine the writing processes of a small group of science journalists. Basically, the think-aloud protocol procedure requires subjects to verbalize their thoughts as they perform some task. Subjects' verbalizations are recorded and then transcribed for analysis. Their verbalizations represent the information they are actively processing from short-term memory. Protocol analysis enables researchers to explore writers' cognitive processing while working on various writing tasks (Flower and Hayes, 1980a; Hayes and Flower, 1980; Berkenkotter, 1981; Berkenkotter, 1983; Pitts, 1982; Schumacher et al., 1989).

Five science writers completed think-aloud protocols for stories based on sessions at either the Twenty-Eighth Annual New Horizons Briefing in Science, organized by the Council for the Advancement of Science Writing (CASW) at the University of Pennsylvania in Philadelphia on November 4-8, 1990 or the American Association for the Advancement of Science (AAAS) meeting in Washington, D.C. on February 14-19, 1991.

Approximately 15 science writers were contacted during the CASW meeting. Seven of these science writers agreed to try the think-aloud procedure; however, only four science writers returned completed protocols. One of the protocols from this meeting had to be eliminated because the tape was inaudible. Approximately 10 science writers were contacted during the AAAS meeting and agreed to participate in this research. Only two of these science writers returned completed protocols.

Each science writer who agreed to participate did a think-aloud protocol as he or she wrote an article based on a presentation, session or news conference. Each science writer received a letter that provided an overview of the research, an instruction sheet and a 60-minute cassette tape.

The instruction sheet requested that the subjects record their thoughts from the time they started to write the article until the time they finished. They were instructed to verbalize everything they were reading, thinking, writing and editing. They also were instructed not to justify or explain what they were writing for the researcher's benefit. This request was made in order to prevent them from altering their normal thinking processes. Each science writer was asked to practice thinking aloud before beginning the actual protocol.

Approximately one month after each conference, a follow-up letter was sent to each science writer who had at least agreed to try the think-aloud procedure. One science writer returned the tape after the follow-up letter. Each science writer who returned the think-aloud protocol received a debriefing letter, which revealed the purpose of the study.

A total of three science writers from the CASW meeting returned protocols and two science writers from the AAAS meeting returned protocols. Two science writers returned the tapes during the conference; the others returned them by mail. Although the low response rate yielded a small sample size, this was not problematic because a purposive sample was used from the onset.

Data Analysis

The think-aloud protocols were transcribed independently by two transcribers and prepared for analysis. Each protocol was divided into T-units, or into independent clauses (Johnson, 1985). Clauses with an implied subject were coded as complete independent clauses. Portions of the protocols were set off by underlined type to indicate when the science writer was writing. Other portions of the protocols were set off by bold type to indicate when the science writer was reading or rereading sections of the article. Portions of the text were left as plain type to indicate when the science writer was verbalizing his or her thoughts. Clippings of the science writers' final version of the articles also were obtained.

Both quantitative and qualitative research techniques were used to analyze the protocols. Quantitative analysis was used to identify trends and patterns among the science writers.

Qualitative analysis was used to explore the science writers' behavior in more detail.

For the quantitative analysis, the primary researcher coded each protocol for items on the coding scheme. The content categories on the coding scheme stem from those used in previous research on the writing process, particularly research conducted by Berkenkotter (1981) and Pitts (1982). These include planning, editing and writing. In addition to these categories another one was added: considering constraints.

Each instance of or reference to one of these tasks was counted in T-units. The percentage of time each writer spent on these tasks was calculated by dividing the total number of T-units for each task by the total number of T-units in the protocol.

Planning was defined as references to or instances of reviewing and evaluating notes, reviewing and evaluating background materials, recalling information presented at the conference, evaluating content to be included in the article, evaluating the organization of the article, reviewing direct quotations or evaluating the use of direct quotations, puzzling over how to present information, puzzling over the meaning of scientific concepts, translating information from notes or reference materials, identifying the angle or focus of the article, thinking about using a literary technique and determining the appropriate tone to use.

Writing was determined by the protocol transcribers. In most cases, the transcribers could easily determine when a subject was writing by listening for the sound of typing. An instance of writing was defined as one T-unit of underlined text.

Editing was defined as references to the following: changing a word or determining which word is most precise, deleting information, inserting information into existing text and checking the spelling of words, including names and places.

Considering constraints was defined as references to and instances of referring to the amount of space allotted for the article, the length of the article and the existing text, and the story deadline.

A subset of the protocols was coded independently by two coders to determine the reliability of the coding scheme. Intercoder reliability was calculated using Cohen's Kappa (Lim, 1991). The average reliability was .84; the individual reliabilities ranged from .62 to .97. Cohen's Kappa was used because it precludes the proportion of agreement that is expected by chance (Cohen, 1960; Lim, 1991).

For the qualitative analysis, each protocol was read closely in order to learn more about the science writing process and to identify patterns in the writers' protocols. For example, the writers' instances of planning were examined to identify whether they focused on content plans or organizational plans, and whether the science writers initiated planning before or during the drafting stage. Also, instances of editing were analyzed more closely to determine the extent to which writers were checking word choice, content or spelling. The writers' considerations of constraints were studied to determine the extent to which writers worried over these constraints.

Results and Discussion

General Description on the Science Writers

In order to maintain confidentiality, the names of the science writers and the news organizations that employed them cannot be revealed. However, three of the five subjects have spent five years or less as science writers, although the number of years of experience ranges from one and a half to 11 years. On average, the science writers have four and a half years of experience in science writing and a little more than four years of experience working at the organization where they are currently employed. Some descriptive information about those news organizations is summarized in Table 1.

Table 1: Description of Science Writers' News Organizations.

	Science Writer 1	2	3	4	5
Type of Publication	Nwsp.	Nwsp.	Nwsp.	Nwsmgz.	Nwsp.
Circulation Size*	265K	56K	1.8M	412K	407K
Frequency of Publication	Daily	Daily	Daily	Weekly	Daily
Distribution	Local	Local	Nat'l	Nat'l	Local
Designated Science Section**	Yes	No	No	Yes	No

Nwsp.= Newspaper Nwsmgz.= Newsmagazine
K = Thousand M = Million

* According to The International Yearbook (Editor and Publisher, 1991) and The Standard Periodical Directory (Oxbridge Communications, 1991)

** According to the most recent SIPIscope survey (Scientists' Institute for Public Information, 1990)

General Description of Protocols

The five science writers who participated in this research produced 57 single-spaced pages of protocol text yielding a total of 1,910 lines. On average, each science writer produced a little more than 11 pages of protocol text; the number of pages of protocol text per writer ranged from three to 15.5 pages. On average, each protocol contained 382 lines of text; the number of lines per subject ranged from 152 to 750. An excerpt from one of the protocols can be found in the Appendix.[1]

Description of the Science Writing Process

Four major writing tasks were analyzed: planning, writing, editing and considering constraints. The science writers spent an average of 20 percent of their time planning their articles, 19 percent of their time writing their articles, five percent of their time editing their articles and two percent of their time considering journalistic production constraints (see Table 2).

The percentage of time each writer spent on these tasks does not add up to 100 because the coding scheme was not designed to capture all of the tasks writers perform during the writing process. Some of the tasks that were not measured include making formatting changes and general musings about the subject of the article.

Table 2: Percentage of Time Spent on Writing Tasks.

	Science Writer				
	1	2	3	4	5
Planning	24%	27%	23%	25%	17%
Writing	49%	6%	21%	28%	11%
Editing	6%	0%	6%	9%	2%
Considering Constraints	3%	1%	2%	2%	2%

As Table 2 indicates, the composing processes of the science writers are similar. Of all the tasks coded, planning and writing were the most time-consuming for the science writers. Three of the five science writers (3-5) spent approximately the same amount of time on planning and writing the article. Science Writer 1 spent twice as much time writing as planning. Science Writer 2 spent four and a half more time planning than writing; however, Science Writer 2's protocol indicates that he had not finished writing the article when he stopped recording (lines 297-298). On the average, the science writers spent approximately equal amounts of time planning and writing.

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[1] For complete copies of all the protocols, please contact the author.

Editing comprised only a little more than 4.5 percent of the science writers' time, on average.

Consideration of journalistic production constraints, such as deadlines and length requirements, took up an average of two percent of the science writers' time. Four of the five science writers mentioned constraints during the writing process.

Based on the qualitative analysis, the following sections provide a more in-depth look at the writing process of each of the five science writers.

Case Study: Science Writer 1

Science Writer 1 has spent three years working as a science writer for a local daily newspaper. She wrote a brief article based on a news conference held at the annual meeting of the AAAS. The news conference focused on the durability of gas masks used by soldiers who were fighting in Operation Desert Storm.

Science Writer 1's protocol reveals that she spends almost no time on planning. Science Writer 1 works steadily through the article from start to finish, occasionally changing words as she composes at the computer (lines 29-31, 44-45). She appears to transform her thoughts into words with ease and with few hesitations. Occasionally, Science Writer 1 repeats words or phrases while deciding what to write about next (lines 59-60; lines 96-99). She also occasionally makes notes about checking information (line 21-22). She rarely rereads the article during the writing process. She makes only two references to editing the article: one to add information (line 62) and one to delete information (line 109).

Science Writer 1 makes only two comments that relate to conventions or constraints characteristic of journalistic writing, one in reference to using a direct quote and one related to space constraints.

Case Study: Science Writer 2

Science Writer 2 has two years of experience as a science writer and has spent three years working at the small daily newspaper where he is currently employed. Science Writer 2 wrote an article based on a presentation about antibiotic-resistant bacteria given at the CASW briefing. Science Writer 2 did not face a very tight deadline; in fact, he had a couple days to work on this article.

Content planning occurs at three different times in the protocol, once when the science writer reads over his notes and background materials and later when he is almost finished with the article. Science Writer 2 spends a substantial amount of time on prewriting planning (lines 1-142). He consults several journal articles and science news articles on antibiotic-resistant bacteria that he collected at the conference (lines 87-89).

While planning, he identifies the angle for his article. He says at the very beginning: "The story I see here is that penicillin, which are antibiotic[s] that most people thought would be the miracle drug, according to Dr. Tomasz and his study [show] that the miracle drug may not be working miracles on any bacterium anymore" (lines 5-10). Working from this angle, he then immediately identifies two potential implications of the article. He says: "So this story is not only a public health story but a certainly has a business or pharmaceutical industry impact" (lines 12-15). He later identifies a different angle he can pursue in a future article. He says: "If I can't bring [it] out in this story, it's a story I'm going to try to focus on in the future about hospitals and what problems they have with resistant bacteria" (lines 54-57).

A distinct feature of Science Writer 2's prewriting planning process is that, while reading over his notes, he sorts out the information he plans to use in the article and the information he does not plan to use. Content planning is the most prevalent planning activity Science Writer 2 uses. He frequently highlights important information. He states: "I think that's a big point in writing this story" (lines 30-31) and "I think that's a very important point" (lines 53-54).

Science Writer 2 also initiates planning while he is drafting the article. After writing a paragraph or two of text, Science Writer 2 stops to consider what information to include next. Near the end of the protocol he maps out what content he still needs to include in the article.

Science Writer 2 spends a considerable amount of time planning whether or not to present scientific information and how to present it. He occasionally has difficulty understanding some of the scientific information presented in the background information or by the speaker, saying: "I don't understand all the terms he uses such as a methicillin or mic, another type of penicillin" (lines 19-22); "I'm not sure I understand all this/ so I'm not going to get involved in that" (lines 118-119); and "I don't really understand" (lines 124-125). He discards any technical information he does not fully understand.

Science Writer 2 spends some time planning how to organize the article. He reorganizes the article and then stops to call the scientist who presented the lecture, as well as several other sources (lines 223-233).

Plans relating to the use of quotations are scattered throughout Science Writer 2's protocol (lines 70-71, 71-72, 66-67, 168-170, 177-178, 178, 229-230, 234-235, 296-287, 291-294). He makes plans for the placement of quotations: "Here is about the time in the story uh when I need to uh bring in a quote," he says. He also makes a point of placing his "best quote" (line 168) near the beginning of the article and he also makes plans about whom to quote (lines 296-287, 291-294).

Science Writer 2 also spends some time planning whom to contact for subsequent interviews (line 76 and 81). He explains at the beginning of the protocol that he thinks it would be remiss to write the article as a one-source story.

Science Writer 2 occasionally plans how to revise the style of the article. At one point he remarks that a phrase is "too colloquial" (line 163) and reminds himself that "it needs to be fixed up" (line 163). At another point he notes that a word "sounds kind of silly" (line 213) and selects another word.

After his initial planning, Science Writer 2 immediately begins to write: "penicillin, frequently called the quote miracle drug by doctors and the public and consumers and doctors and consumers alike, may not longer be as great as it once was/ or something to that effect" (lines 142-146). He rereads the lead, modifies it to some extent and in less than a minute he moves on to writing the rest of the article.

Science Writer 2 is generally pleased with what he has written. He says: "O.K. I've got most of the story written up here/ it's still coming out just as I wanted" (lines 297-298). He encounters few problems while writing. After extensive planning, he writes quickly and maintains the focus he set up in the lead.

Science Writer 2 does not edit the article. However, he notes places in the text that need editing: "need to work on that paragraph" (line 157) and "it needs to be fixed up" (line 163).

Science Writer 2 refers to the journalistic conventions related to quoting sources (lines 70-72) and space constraints.

Case Study: Science Writer 3

Science Writer 3 has spent one and a half years working as a science writer for a national newspaper. Science Writer 3, like Science Writer 2, wrote an article based on the presentation about antibiotic-resistant bacteria given at the CASW briefing. Science Writer 3 wrote the article at a computer almost immediately following the scientist's conference presentation. The article was scheduled to run the next day, so he faced an extremely tight deadline.

Science Writer 3 does not spend any time planning prior to writing.

Like Science Writer 1, Science Writer 3 starts writing the article immediately. Unlike the other science writers, he does not identify the angle of the article.

Like Science Writer 2, Science Writer 3 alternates between planning and writing. He spends almost an equal amount of time planning and writing. Content plans are an important part of Science Writer 3's writing process. He usually makes content plans after writing a sentence of text. Science Writer 3 uses global and local content plans. A global content plan is one in which he refers to the entire article, for example: "I need to get this set up broadly enough so I can go back and explain some of these issues later" (lines 44-46). A local content plan is one in which he refers to an isolated portion of the text, for example: "I got to get penicillin in the lead" (lines 79-80).

Science Writer 3 makes content plans about including scientific information in the article, for example, "let's see, I've got to make sure I keep this notion of mutation" (lines 299-300). He makes content plans about translating scientific information, for example, "find some way to make this a little bit, to broaden this out a little bit/ I feel this is a little bit too, uh too inside baseball here" (lines 66-68). He also makes numerous content plans about including general (nonscientific) information, for example, "I'm going to say that now" (line 375).

Organizational plans are scattered throughout Science Writer 3's protocol (lines 158-159, 167-171, 175-176, 285-286). For example, he says: I'm going to move this discovery with broad implications to the second paragraph/ and uh uh let's see/ I'm going to bring that quote up high about the arms race" (lines 169-171). Science Writer 3 usually makes organizational plans after he rereads a section of the article or after he writes a portion of the article. Examples of organizational plans include: "I'll use that list later" (line 22-32); "following paragraph, I'm going to move this discovery with broad implications [section] to the second paragraph" (lines 167-169).

Sometimes Science Writer 3's references to organization indicate his confusion about how to organize the article. For example, "I don't know where it's going to go" (lines 216-217). At other times, Science Writer 3's comments serve to remind him to change the organization of a particular passage. For example, "I'll get to this [information] later" (lines 269-270).

Science Writer 3 maps out the content of the article as he composes; however, he seems to have some kind of an overall organizational scheme in mind. He seems to know just what goes where. For example, on lines 109-110 he says, "OK, now I'll get into some of the background here." Later he says, "I'm going to get into this one that turns them hungry, here this pneumococcus" (lines 127-128); "[in the] following paragraph I'm going to move this discovery with broad implications to the second paragraph" (lines 167-169); "no I need to say what the trick is here right now" (lines 192-192); "what I need to do is go back to the notion that this could help finding [out] about the structure the molecular structure of the new chemical defenses [that] are retailored" (lines 570-573); "[put] this awesome power quote here" (line 283); and "now I'm going to get into another one of these awesome quotes" (lines 311-312).

Like Science Writer 2, Science Writer 3 spends a considerable amount of time puzzling over how to present scientific information. Occasionally, he develops analogies to describe scientific phenomena. In explaining how bacterial cells defend themselves against attack from antibiotics, he uses a "lock and key analogy" (line 623). He writes: "in essence the antibiotic is a key that fits into a lock on the cell wall" (lines 631-632). He then extends the analogy to further explain this scientific phenomenon. However, his attempts to explain complex information using analogies are not always successful.

In explaining how more sophisticated antibiotics are able to kill resistant bacteria by tricking them, he realizes that his analogy will not work. He says: "Um, it's almost a Trojan horse kind of no it's not a Trojan horse" (lines 208-209).

Science Writer 3 also spends a considerable amount of time planning how to express something in writing. He often puzzles over his writing, for example, "that still doesn't sound quite right" (lines 30-31); "it still isn't there" (line 82); "I don't know what to say" (line 205); and "that's not quite what I want to say" (lines 232-233).

Science Writer 3's writing process is very recursive, he shifts quickly from one writing task to the next. Throughout the protocol he juggles planning, rehearsing portions of the text, writing, rereading the text, reading notes and editing.

When composing, science Writer 3 relies heavily on information from his notes. He does not review his notes before starting to write but instead refers to his notes periodically as he writes.

Science Writer 3 spends a significant amount of time composing the lead (lines 1-90). He struggles to develop a concise, interesting lead at the beginning of the protocol. Soon after writing the lead he explains that: "The lead's already too long/ I like to have a lead that's no more than three lines/ I'm already two and a half into it here" (lines 9-11). After making minor revisions he is still not pleased with the lead. He says, "I haven't got this quite right/ the lead is not uh I got to redo that a little" (lines 13-15). At this point, he calls either a colleague or an editor for advice. He says: "I called this in to Neal/ he used the word trick" (lines 19-20). He rereads and revises the lead several more times (lines 30-31, lines 44-46, lines 51-52, lines 65-68, lines 82-83). After he rereads the lead for the sixth time, he still is not satisfied with the lead but continues to write the rest of the article. He says: "Too many that's/ and it's still too long/ but I'm going to leave [it] for now" (lines 88-90).

Science Writer 3 often rehearses information before adding it to the text, especially when trying to find the most appropriate word. He frequently searches for the "right word" (lines 114-123, 375-376). He says: "different version or strains or different derivatives/ what's the right word here" (lines 116-177). Word choice also is an important consideration for Science Writer 3.

Science Writer 3 is quite critical of his writing. During the writing process, he seems to rely on internal rules to help him monitor his writing. The first instance of his use of one of these rules is when he evaluates the lead. The rule is: "I like to have a lead that's no more than three lines" (lines 9-10). He also seems to have a rule governing the use and placement of quotations. For example, he says: "I need to quote Tomasz here" (lines 54-55). He also refers to a rule about redundancies. When he rereads the lead, he says: "too many that's (lines 88-89). At another instance he says: "I've got resistant in here too many times (lines 373-374). He also express concern about presenting too much scientific information in one sentence. At one point he realizes that he has referred to two different infections: "I don't like to have two infections in one sentence" (lines 131-132).

Most of the Science Writer 3 seems to have a sense of where to place information in his article. He says, "Near the end of the story [I] got to get that in there somewhere" (lines 544-545). At the end of the protocol he remembers that "there's one thing [I] wanted to get to," (line 687).

At times, however, he is somewhat unsure where to incorporate material into his organizational scheme. He says: "Maybe I should just move this discovery with broad implications into the second paragraph/ although I guess we all know that/ [otherwise] I wouldn't be writing it" (lines 158-160); "I don't know where it's going to go/ going to write it down now/ get it into the story" (lines 216-218); "let's see how do I get [to] Hungary/ how do I get Allan Green and the drug Imipenen" (lines 274-275).

Science Writer 3 does some editing as he writes. He recognizes where gaps or holes in his article exist and gathers more information to fill the gaps. He talks about the development of new medicines that allow scientists to re-tailor antibiotics. He states: "I better describe this um got to describe the ... think I need to spend a little time thinking about I got to uh which developments ask him more a little bit more about that" (lines 582-585). Later he lists questions on a piece of paper to ask his source (lines 279-280). He also stops to check the spelling of a name, a city and a word (lines 326-327, 438, 484-485).

Comments from Science Writer 3's protocol reveal that he feels somewhat pressured by his deadline. He asks: "What time is it here" (line 553) and responds, "Yikes" (line 553). At times, Science Writer 3 also appears to be concerned about the length of the article. He asks: "How long [am I] at here" (line 505). In addition, Science Writer 3's frequent deletions also may indicate an effort to meet length requirements.

Case Study: Science Writer 4

Science Writer 4 is the most experienced of all the science writers in this study. Science Writer 4 has spent 11 years working as a science writer and two years working at the news organization where he is currently employed. Unlike the other science writers, he works for a newsmagazine instead of a newspaper. Science Writer 4 wrote an article based on a presentation about organizations and risk presented at the CASW briefing. Unlike the other science writers in this study, Science Writer 4 did not face an imminent deadline. In fact, he wrote the article a couple months after the seminar. Although he was working under some space constraints, he was allotted more space for his story than were the other science writers.

Like Science Writers 1 and 3, Science Writer 4 begins writing the article almost immediately. He does not spend time planning before he starts to write. After he sets up the lead, he identifies the angle of the article. He says: "All right now we need a bill board graphic/tell us what this stupid story is all about/ that is how people studying new organizations ... have figured out how to prevent these kinds of accidents" (lines 27-31).

Like Science Writers 1 and 3, Science Writer 4 also alternates between writing and planning. His writing generates planning that, in turn, generates more writing. Like Science Writer 3, he seems to have an internal organizational scheme or pattern for mapping out the content of the article. After writing a portion of the text, he quickly plans what information to use next.

Some examples of the content plans he makes are: "Got one [graph] on accidents/ one on accidents in general" (lines 80-81); "Either go right to the thing about the hierarchical structures being more fluid or we go to the technological thing which is more interesting and more compelling but probably less important to what they found out/ so should probably go with that" (lines 124-128); "ah we'll go to that notion of people think it's so important" (lines 135-136); "uh we need something about [technology] (line 189), "need to say which ones they are" (lines 194-195); and "need to get this people vs. technology notion in here" (lines 203-204). These content plans indicate that Science Writer 4 is fairly certain of what information he wants to include in his article.

Although much less frequent than content plans, organizational plans appear throughout the protocol. Again, Science Writer 4 alternates between making organizational plans and writing. He seems to have an overall organizational scheme in mind that helps him monitor his writing. Some examples of the organizational plans he makes are as follows: "Start a new graph here" (line 64); "I won't put that in till later" (line 115); "we'll start with the first word" (line 362).

Although Science Writer 4 usually seems to know exactly what content to use or how to organize the article, once in a while he does stop to puzzle over the content and the organization. For example, he says: "I'm not sure if I need a quote here" (lines 93-94); "no maybe we should throw in that fact" (lines 152-153); "maybe I should put that quote as the last one" (lines 159-160); "devotional do we want this devotional stuff" (line 575).

Science Writer 4 appears to be quite concerned about the use of quotations and the placement of quotations in his article. He makes 19 references about using or looking for quotations (lines 102-104, 106-107, 109-110, 156-157, 174-175, 185, 356, 356-357, 357, 357-358, 369, 419, 478-479, 480-482, 523-524, 543, 547, 603, 638-639). For example: "We're looking for a quote a good quote to use about new types of organizations" (lines 106-107) and "we need to get these ideas into a shorter quote" (lines 174-175)

Of all the science writers examined in this study, Science Writer 4 is the most concerned about word choice. At 25 different instances, Science Writer 4 ponders over which word to use in the article (lines 22-23, 59-60, 66, 71-72, 78-79, 119, 144-145, 167-172, 208-211, 235-237, 255-256, 266-268, 274-279, 285-286, 317-319, 325-326, 359-361, 393-395, 458-464, 509, 552-554, 577-579, 584-585, 587, 588), for example, "one surprising resounding one strong one one emphatic one" (lines 144-145). At times, Science Writer 4 provides a string of synonyms as he searches for the right word: "In fact says LaPorte the organizations the so-called high biologists are finding these discovering these discovering finding these discovering these discovering finding these discovering studying studying these investigating probing probing oh discovering discovering these in their heads" (lines 167-172).

Science Writer 4 rarely writes more than a sentence or two at a time. After writing, Science Writer 4 usually stops to make content plans, to make organizational plans, to change a word, to review notes, to locate a quote or to check spelling. He frequently interrupts himself to contemplate word choice.

Another distinctive feature of Science Writer 4's writing process relates to how he handles factual information such as names and figures. When he cannot find certain factual information, such as a person's name, a date or a figure, he writes TK (traditional journalistic shorthand for "to come") in the text of the article to remind himself to look up that information later (line 46, 47, 48, 114, 115, 116, 228, 288, 353, 417, 475).

Science Writer 4 does more editing than any of the other science writers, but he still does not edit much. His main concern when editing is word choice.

He periodically checks the length of his article (lines 293-296, 436-237, 440-441, 561-562). For example, he says, "let's word count/ let's see how we're doing here/ word count 386 words I should probably write about 1,000 words" (lines 293-296). His references length appear to be simply a way to monitor his progress; he does not appear to be worried that the article is getting too long.

Case Study: Science Writer 5

Science Writer 5 has spent five years working as a science writer for a daily newspaper and he has a total of 13 years of experience with that newspaper. Science Writer 5 wrote an article based on several presentations from a session about current conceptions of intelligence at the AAAS meeting.

Like Science Writer 2, Science Writer 5 spends a considerable amount of time on planning before starting the article. In fact, lines 1-369 of the protocol text record his prewriting planning.

Science Writer 5 identifies the angle of the article during his prewriting planning. He says: "I'm going to focus this story on their ideas/ probably more on Garner's idea of creativity" (lines 26-28).

Science Writer 5's prewriting planning only includes plans about the content of the article. As he sifts through his notes, scientific conference papers and a concise dictionary of biology, he selects information to include in the article (lines 33, 34, 35, 57, 85-86, 87-88, 97-99, 109-110, 110-112, 198-202, 214-215, 230-232, 249-250, 291, 367-368). At times, he is critical of what he reads (line 141, lines 152-153). For example, in reference to a comment made by one of the scientists he says: "I don't believe he believes that" (lines 152-153).

The papers and articles that Science Writer 5 reads in the course of writing help him recall information from the sessions he attended at the AAAS meeting. He says, for example, "what I remember from his talk is that executive style is people who like rules and follow rules and all that stuff" (lines 71-73); "if I recall he was big on culture" (lines 104-105); and "mathematical science which I think he said is the most traditional" (lines 222-223).

During prewriting planning, Science Writer 5 also identifies information to use in his lead. He says: "he may be the one who compared Einstein and Mr. Stravinsky and that might make a good lead" (lines 97-99). He does later return to this information and uses it in the lead (lines 369-373).

Once Science Writer 5 starts to write, he alternates between writing and planning, like many of the other science writers (except Science Writer 1). Content plans and organizational plans frequently follow instances of writing. Some examples of these plans are: "In the next part I want to get four names up here" (lines 376-377); "this is the junk stuff that's got to go in here/ and it's too high in the story/ and it's getting in the way" (lines 411-412); "all right now set the scene a little bit" (lines 428-429); "OK now I need to take him [the source] to the concluding statement" (lines 557-558).

Science Writer 5 makes global content plans: "so I will keep it focused/ I will stick with Gardner" (lines 485-486). He also makes local content plans: "OK all right I better get that in/ that's my kicker/ OK let's get the comments in here" (lines 581-583).

In addition to content plans and organizational plans, he also makes an occasional reference to planning on whether to use a quote and where to place it. For example, he says: "OK a quote here a definition quote from Gardner" (lines 448-449); "I want to get that quote in at the end of the story" (lines 577-578); "don't quote this from his paper" (line 642); "let's stop the quote and rephrase it" (lines 687-688); and "I need to set up this quote" (lines 717-718).

Science Writer 5 also has an internal sense of how the article should be written and he uses this to monitor his writing as he works. For example, he says: "It's too jarring" (lines 375-376); "this is all boring stuff" (line 391); "I'm trying to do it clearly and make it precise" (lines 412-413); "this sentence doesn't make sense" (lines 406-407); "what am I talking about here" (lines 379-380); "all right I don't like the way this sounds here" (lines 453-454); "I'm getting wordy" (lines 463-464); "that's not going to work" (lines 589-590); and "that's too confusing" (line 687).

As he writes, Science Writer 5 occasionally refers to his notes, the conference papers and a biology dictionary (lines 387-388, 391-392, 531-532, 623-624, 624-625, 629-630, 692, 705).

While writing he occasionally tests the organization of his writing: "all right put this in the middle of a sentence/ and see if it's not too disruptive" (lines 395-396)

Science Writer 5 does some editing. He deletes redundant material (line 601, 628-629). Once in a while he expresses concern about his word choice. He says: "I've use the word traditional too many times" (lines 442-443) and "ignoring is a better word" (lines 649-650). He also checks the spelling of words, including the spelling of names (509-510, 626-627, 663, 740-745).

Science Writer 5 makes a few references to production constraints. At the beginning of the protocol he notes the time and space constraints he faces (lines 10-15). And later he says: "it's not going to be terribly long/ those decisions have already been made/ but they've been known to change as I write" (line 317-319). He notes the story is scheduled to run the next day, but he is interrupted as he is reading over background information and holds the story for a day (line 309). He occasionally checks the amount of time he has until deadline and the length of the article (line 170-171, 516-518, 529-530, 531, 701-702). About half way through the article he measures its length: "OK I need a length measure/ let me find that/ OK 28 lines/ I can go to about 50 to 60 lines" (lines 516-518).

Summary of Protocol Analysis

The protocols showed that the science writers in this study initiated many of the same tasks other professional writers do. However, the ways they carried these out and the frequency with which they initiated them differs. These differences can be explained by examining the unique contextual constraints science writers face.

The protocols of the five science writers indicated that planning was an important part of the science writing process, in fact, equally as important as composing the article. Most planning was initiated as the science writers were composing their articles. Unlike other professional writers, the science writers rarely relied on prewriting plans. Science writers' use of prewriting planning seemed to be directly related to their familiarity with the subject of the article. If they were unfamiliar with the subject of their articles, they tended to use more prewriting plans.

The apparent lack of prewriting planning during the science writing process can be explained in a number of ways. Because most of the science writers were working under deadlines, they may not have had much time to spend on prewriting planning. Another explanation is that the science writers did not need to spend as much time on prewriting planning because their previous knowledge of and experience in newswriting. The science writers, may be because many science writers are already familiar with their beat and have had some training in science. Another possible explanation is that this activity simply was not captured by the think-aloud protocols. The science writers may have made prewriting plans before they actually started to record their think-aloud protocols.

The qualitative analysis of the protocols revealed that once the science writers started composing, they used more local plans than global plans. After their initial identification of the angle or the slant of the article, the science writers rarely set global plans or plans about the entire article. They concentrated on planning small portions of their article.

Science writers may find local plans more efficient than global ones because local plans complement the structure of most news articles. Most news articles follow the inverted pyramid structure in which the journalist presents a string of related ideas in order of importance. Each idea is presented in one paragraph that usually contains one complete sentence. This structure promotes the use of local plans because journalists can work on one paragraph at a time and quickly move from one paragraph to the next. This finding confirms similar results by Pitts (1989) who also found that journalists set short-range goals and plans for the paragraph or sentence as they write.

The qualitative analysis of the protocols also showed that the local plans the science writers used the most were plans related to the content and organization of their articles. Of the two types of plans, the science writers spent more time on content than organization plans. The science writers initiated local content plans when they encountered a new idea they wanted to incorporate into their articles. These were generated by recalling information from a news conference, conference session or interview; rereading the previous paragraph; or reviewing background materials like conference papers or science journal articles.

One reasons the science writers may have used a lot more content plans than organizational plans is because they had more trouble determining what information to include in the article than where to place that information in the article. The science writers' more extensive use of content plans reflects more active cognitive processing in regards to developing the content of their articles. The science writers did not have prior knowledge about what content to select in the article. Using content plans may have helped the science writers quickly sift through a lot of information to help them develop their stories.

The science writers may have initiated fewer organizational plans because they had preexisting knowledge of how to organize their articles. They could rely on schemas or stored information about conventional news structures. Because of their experience and previous familiarity with conventional news structures, they did not need to spend as much time actively processing information about how to organize their articles.

The analyses of the protocols showed that most of the time writing proceeded smoothly for the five science writers. Like both student and professional writers, the science writers were recursive writers; that is, they "shuttle back and forth from what they wanted to say, to the words they have written, and back to their inward sense of ideas" (Brannon, 1985, p. 11). While composing, all of the writers seemed to have an internal sense or "felt sense" (Perl, 1980) about what information to include, where to include it and how to present it. They knew when they "need" to use a quote, to move a paragraph and to clarify or revise the article. The protocols indicate that many of them recalled internal rules they have developed about word choice, organization and use of quotations.

This internal sense may stem from science writers' previous knowledge of journalistic writing routines and the structure of news articles. Journalists rely on routines and automated procedures to reduce the amount of information that requires conscious processing in short-term memory (Flower and Hayes, 1980a). The protocols suggest that science writers activate schemas or information in long-term memory, and then recall this information into short-term memory when needed. Journalists' knowledge of news structures and routines is obtained through the training and experience they receive in the newsroom.

This study also found that the science writers were particularly concerned about the use of direct quotations in their articles. The science writers' focus on the use of quotations appears to be a unique aspect of the journalistic writing process. In their protocols, the science writers periodically stopped writing because they "needed a quote."

This emphasis on the use of quotations may reflect the science writers' attempts to add credibility to their articles. Research indicates that science writers and their editors are especially concerned about the credibility of their articles and the sources they use (Dunwoody and Ryan, 1987).

The protocols showed that the science writers spent little time editing their articles. The science writers occasionally checked spelling and factual information, deleted information, inserted information, or filled in the gaps they noticed in their writing. But, basically they left the rest of the editing for the editor. The fact that the science writers spent so little time editing their articles appears to be directly related to the one of norms of the journalistic profession: tight deadlines. Working under deadline pressure, they do not have much time for revisions. In addition, they may also feel that they do not need to do much editing, because they know their articles will be reviewed by at least one editor before it is published.

The protocols showed that all of the science writers were conscious of journalistic constraints. Most of the science writers in this study faced time and space constraints. References to these constraints surfaced periodically throughout the protocols, whenever the writer wanted to check the length of the article or the amount of time left to write the story. The science writers' references to the constraints under which they were working reflect the unique rhetorical situation journalists face. Other professional writers usually do not work under such severe constraints.

Conclusions

This study provided information on how five professional science writers processed information as they worked on articles at a national scientific conference. The analysis of the think-aloud protocols from these science writers provided specific information about some of the tasks the science writers initiated during the newswriting stage of the science writing process. Because the science writers were studied in their natural work environment, this study was able to examine the effects of contextual constraints on the science newswriting process.

The protocols of these science writers suggest that their processing of information was affected by journalistic rules and conventions. Many of the cognitive strategies they used to process information were employed because of the contextual constraints they faced, such as deadlines, space limitations, editorial preferences and stylistic conventions. The protocols also suggest that the science writers internalized and routinized many tasks so that they could spend more time on other tasks that required more rigorous cognitive processing.

As with any methodology, protocol analysis has its limitations. Some researchers have argued that this methodology distorts normal processing of information (Nisbett and Wilson 1977; Steinberg, 1986; Dobrin, 1986). They add that protocol analysis cannot capture tacit information, the information writers hold subconsciously in memory. However, other researchers have countered these criticisms by arguing that the methodology only distorts process on information when researchers ask subjects for information they would not otherwise have attended to while performing a task (Ericsson and Simon, 1980). Although these researchers found that protocol analysis does not disrupt normal cognitive behavior, they do admit that it slows down behavior (Ericsson and Simon, 1980, 1984). They warn that researchers should recognize that think-aloud protocols should be "elicited with care and interpreted with full understanding of the circumstances under which they were obtained" (Ericsson and Simon, 1980, p. 247).

Another limitation of protocol analysis is that it is extremely labor-intensive. Because of the richness of the data derived from think-aloud protocols, researchers often study only a limited number of subjects. Most studies of writers that use protocol analysis examine fewer than 10 subjects (Berkenkotter, 1981, n=10; Berkenkotter, 1983, n=1; Flower and Hayes, 1980a, n=1; Hayes and Flower, 1980 n=1; Kirsch, 1991, n=5; Pitts, 1982, n=3; Schumacher et al., 1989, n=4). The descriptive information derived from protocols often indicate various patterns of behavior; however, because of the small sample sizes used in most studies, these patterns cannot be generalized to larger populations.

The results of this study are also subject to these limitations. Although the think-aloud protocols provided a great deal of information on the ways science writers process information while writing science news article, the protocols could not capture the tacit knowledge science writers use during this process. In addition, because of the small sample size, the results of this study cannot be generalized to a larger population.

Still, this study shows that protocol analysis does provide researchers with a wealth of information about subjects' cognitive behavior (Swarts, Flower and Hayes, 1984). As Berkenkotter (1983) explains: "The value of thinking-aloud protocols is that they allow the researcher to eavesdrop at the workplace of the writer, catching the flow of thought that would remain otherwise unarticulated" (p. 167).

Despite the difficulties of soliciting cooperation from journalists and the limitations of protocol analysis, more research is needed on the science writing process and the ways journalistic constraints affect the content, structure and style of science news articles. This study is only the beginning towards understanding the science newswriting process. More research needs to explore how science writers process information. Future research needs to address the following questions: How do science writers determine what sources of information to use in their articles and what sources to discard? How do science writers process information from notes, news releases, fact-sheets, journal articles and other written sources? What strategies do science writers use to translate information for their audience? How do science writers' perceptions of their audience affect the way they select and process information? What specific effects do production constraints, journalistic conventions and stylistic or writing conventions have on the content, structure and style of a science news article? Research that addresses these questions will help build our understanding of the complex cognitive activities science writers initiate throughout the science newswriting process.

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Appendix
Excerpt from Protocol of Science Writer 3

I'm going to start writing uh a story based on the Tomasz presentation dateline Philadelphia/ biologists uh have discovered the bacteria that cause pneumonia staff infection / I'm not sure how shall I'll call it either streptoccoccus infections or viral infections/uh cause pneumonia meningitis and virulent other virulent infections that develop powerful ways to fend off/ uh I need to come up with a the lead's already getting too long/ I like to have a lead that's no more than three lines/ I'm already two and a half into it here/ a let's see/ to fend off the arsenal of antibiotics intended to kill the bacteria ok the um bacteria uh I haven't got this quite right/ the lead is not uh I got to redo that a little/ **biologists have discovered that the bacteria that cause pneumonia, meningitis and other virulent infections have developed powerful ways to fend off uh the arsenal of antibiotics intended to kill the bacteria/** I called this in to Neal/ he used the word trick/ I think I got to move discovered the bacteria um the disease causing bacteria instead of all that list/ I'll use the list later/ disease causing bacteria have developed powerful developed a powerful trick that enables them to resist the impact of uh penicillin and other antibiotic dependent killers/ **biologists have discovered that the disease causing that the disease causing bacteria** delete the word/ the **disease causing bacteria develop a powerful trick that enables them to resist the impact/** that still doesn't sound quite right/ this guy was this guy was remarkably good at at describing this in easily understandable ways/ **biologists have discovered that disease causing bacteria have developed a powerful trick that enables them to resist the impact of penicillin and other antibiotic dependent killers/** in fact the bacteria which cause such disease which cause pneumonia, meningitis, ear infection uh and other um and other viral infections um that I don't want to do um import from outside sources new genetic material foreign genetic material foreign genetic material that that enable cell walls to build new defenses against the uh against the antibiotics/ like I need to get this set up broadly enough so I can go back and explain some of these issues later/ uh implications the discoveries discovery has broad implications for public health officials concerned about the spread of disease as well as scientists uh who develop new drugs to combat infections/ uh the six billion dollar industry/ I’m trying to see if I can get that in here/ the uh the world-wide market for antibiotics uh exceeds six billion dollars/ I’m going over my notes/ uh I need to quote Tomasz here/ get a human voice into this story/ uh by seeking control over these bacteria we also started an armaments race with them says uh Tomasz/ I’ll get his name later here scientist microbiologist at Rockefeller University in New York/ see if I can get his title get it correct/ go back and have a look at this again/ **biologists have discovered that disease causing bacteria** uh make this lead much stronger/ that bacteria responsible no, that bacteria uh that cause many of the world’s most common, whereas, no that’s not the right word/ find some way to make this a little bit, to broaden this out a little bit/ I feel this is a little bit too, uh too inside baseball here/ let’s see/ the virus **biologist have discovered that bacteria** for many of the world’s common infectious diseases have developed powerful tricks that enable them to uh escape the effect of medicines intended to kill/ I want to talk about this more in genetic materials in a second/ **biologists have discovered that bacteria for many of the world’s common infectious diseases have developed a powerful trick that enables them to escape/** uh that undermines the shield that shields them that shields them from the uh oh let’s see/ that shields them OK I got to get penicillin in the lead/ I think that will help/ from the effect of penicillin and other antibiotics intended to kill them it still isn’t there/ it still isn’t there/ I’m just getting rid of a bunch of excess words here/ **biologists have discovered that bacteria for many of the world’s common infectious disease have developed a powerful trick that shields them from the effects of penicillin and other antibiotics intended to kill them/** too many that’s/ and it’s still too long/ but I’m going to leave for now/ um **in effect, those bacteria that cause pneumonia, meningitis, ear infections and other viral infections** import sources import sources they import foreign genetic material that enables them to build to build new defenses **against the antibiotics/ the discovery has both broad**

implications for both public health officials uh both public health officials concerned about the spread of the disease as well as scientists seeking to develop new drug to compact infections/ world wide antibiotic market world-wide market for antibiotic exceeds six billion dollars/ in seeking to control these bacteria we also started an armaments race with them says speaker Alexander Tomasz/ um something says, as this race as scientists develop increasingly uh effective treatments bacteria appear to uh quickly find ways to uh minimize or undermine their effectiveness/ too many [inaudible] in this paragraph/ but increasingly powerful treatments OK now I’ll get into some of the background here/ uh scientists have known almost since penicillin first came on the market in 1941 that bacteria uh soon become resistant that some bacteria soon become resistant soon develop develop resistance to some uh versions of penicillin to some/ uh going through some notes here/ different versions or strains or different derivatives/ what’s the right word here/ forms there forms to some forms of antibiotics uh some forms of antibiotics and more than uh already more than 45 thousand um different version or different uh my other machine has a thesaurus/ and this one doesn’t/ **already more than 45 thousand different** varieties of penicillin like like products have on the market um and and for some strains of bacteria nearly all of them are useless/ uh for instance methacillan is used to treat methacillan what was that one used for I don’t/ I’m going to get into this one that turns them hungry, here this pneumococcus/ uh let’s see control/ **in effect the bacteria that causes meningitis and other viral infections** I don’t like to have two infections in one sentence/ **import foreign genetic material** in order to I think what I need to say is previously scientists have uh thought believed that the main mechanism for developing resistance was to take a mutation of genes already uh a mutation of the bacteria’s own gene own genes OK OK that another part of the second paragraph/ **in effect the bacteria which causes pneumonia, meningitis, ear infections and other uh virulent um** ailments import **foreign genetic material that enable them to build new defenses against antibiotics/ previously scientists have believed that the main mechanism for developing resistance** was through mutation of the bacteria's own genes/ **this discovery carries implications for public health/ um scientists have known** uh not going well at the moment/ **scientists have discovered discovery has brought implications** I don't feel like this moves/ I don't feel like I've have got the reader in this story at all/ story yet I don't feel like I've got much punch at the top here/ **biologists have discovered biologists have discovered that the bacteria bacteria that cause many of the world's common infectious diseases have developed a powerful trick that shields them from the effects of penicillin and other antibiotics intended to kill them/ in effect** maybe I should just move this discovery with broad implications into the second paragraph/ although I guess we all know that I wouldn't be writing it but um **discovery as broad implications for both public health officials concerned about the spread of the disease as well as scientists seeking to develop new drug to combat infections/ the world market for antibiotics exceeds six billion dollars/** uh come on trouble dealing with a key on this computer/ following paragraph I'm going to move this discovery with broad implications to the second paragraph/ and uh and uh let's see/ I'm going to bring that quote up high about the arms race/ I need to set that up in a way that makes it clear what that's about/ um it's almost a leap frog kind of thing/ but **discovery with broad implications by seeking control over these** maybe that would work/ control over here we go/ move that quote paragraph up/ **biologists have discovered that bacteria that cause many of the world's common infectious diseases have developed a powerful trick that shields them from the effect of penicillin and other antibiotics intended to kill them/ the discovery has broad implications for both public health officials concerned about the spread of disease as well as scientists seeking to develop new drugs to combat infection/ the world-wide market for antibiotics exceeds six billion dollars/ by seeking control over these bacteria, we also started an armaments race with them said Alexander Tomasz, a microbiologist at Rockefeller University/ as scientists develop increasingly powerful treatments the bacteria appear to quickly find ways to undermine their effectiveness/** now do I want to go to Hungary and the **in effect the bacteria/** no I need to say what the trick is here right now/ **in**

effect the bacteria that causes pneumonia, meningitis, ear infections and other viral ailments import foreign genetic material / uh dash from sources from sources that are currently disparate **that enable them to build new defenses against antibiotics/ previously scientists have believed that the main mechanism for developing resistance to disease was through mutation of the bacteria's own genes/** I don't know if that's clear enough yet/ uh penicillin now I've got to say if penicillin works/ penicillin and its uh uh the derivative class/ I don't know what to say/ and its descendants and its more I guess more sophisticated descendant drugs kill bacteria by tricking/ let's see/ um it's almost a Trojan horse kind of no it's not a Trojan horse/ they make they sort of they trick them trick them into thinking their friendly/ uh by I guess a more sophisticate/ uh descendent's not quite the right word/ um kill bacteria by by I wrote that down here somewhere/ bacteria let's see where is this targets actually 90% of staff have acquired the skill to um break a molecular bond that renders penicillin ineffective/ keep this/ I don't know where it's going to go/ going to write it down now/ get it into the story/ penicillin itself is now rarely prescribed/ 80% of staphylococcus staphylo infection bacteria have acquired the skill to break a crucial uh molecular bond molecular bond that renders it ineffective/ then again, what was it that made it effective tricking penicillin/ let's see/ penicillin and um penicillin and the increasingly more sophisticated antibiotics invented actually more sophisticated derivative derivative drugs kill bacteria by tricking them by tricking them into thinking actually by mimicking by mimicking other compounds of routine entry into the the bacterial cell/ penicillin once inside the cell they essentially explode killing the cell/ that's not quite what I want to say/ but um uh let's see/ then I can say I should get this Hungary thing up fast higher/ I need to get the idea that the finding in Hungary underscores this situation/ **once inside they eventually explode killing the cell/** uh save it/ ok mimicking other compounds mimicking other [inaudible] based compounds in entering bacterial cells/ once inside they eventually explode killing the cell/ um that's not quite what I want to say but/ uh that's ok/ I want to say if it's Hungary